ARCHIVES OF

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3rd International Congress of Physical Medicine

IIIe Congres international de Medecine Physique

3° Congreso internacional de Medicina Fisica

3. internationaler Kongress für Physikalische Medizin

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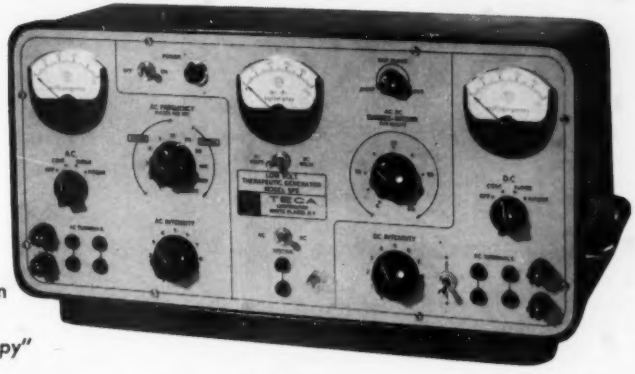

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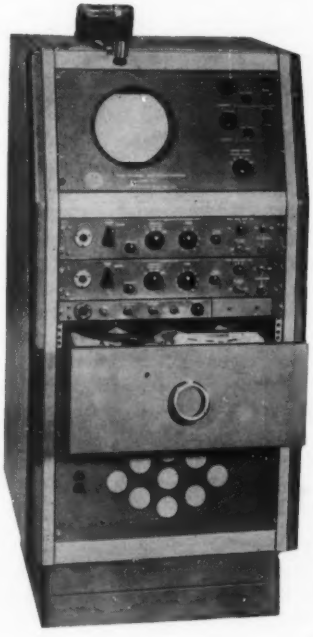

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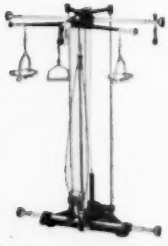

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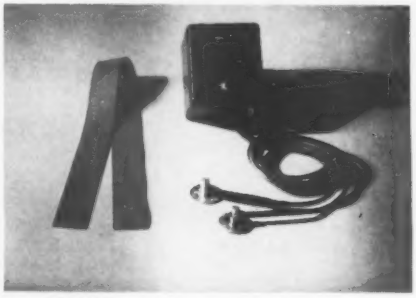

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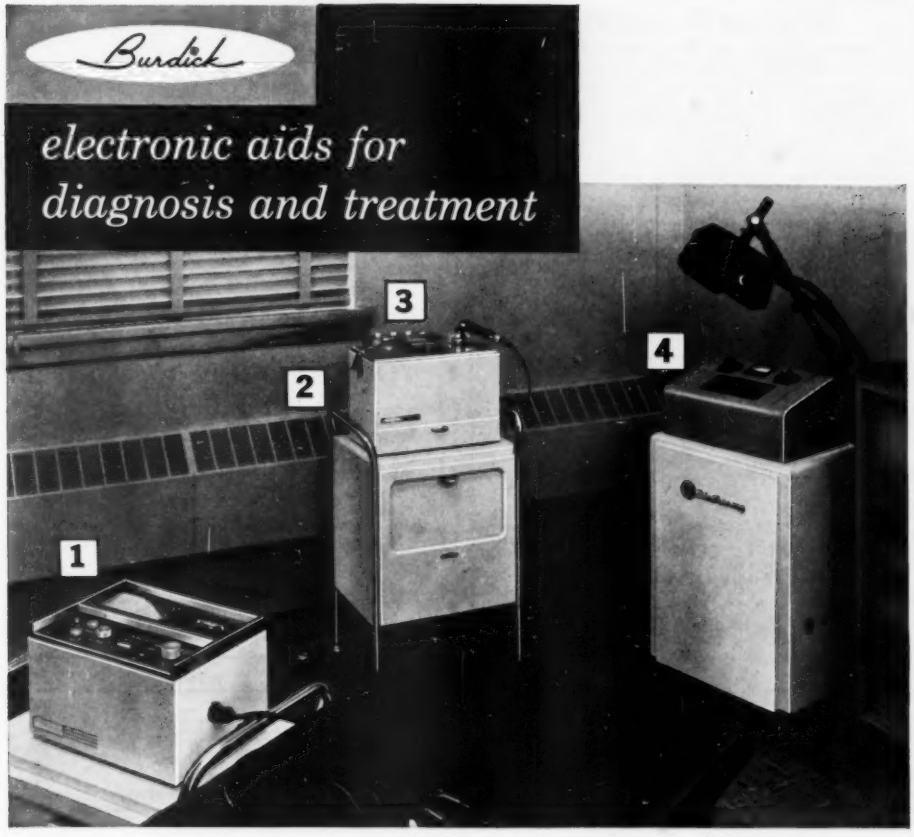

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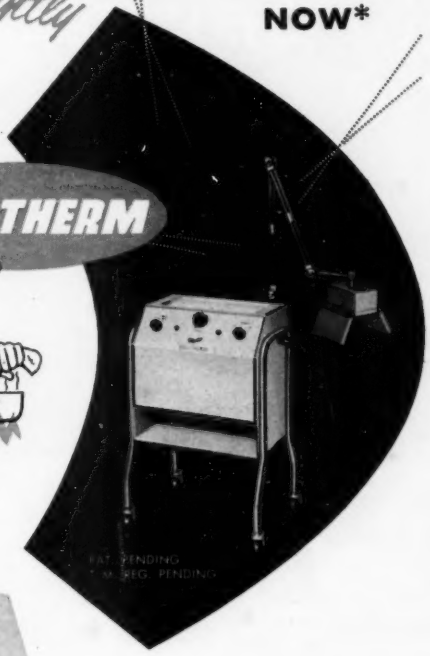

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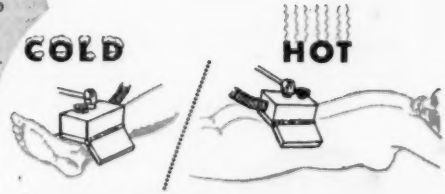

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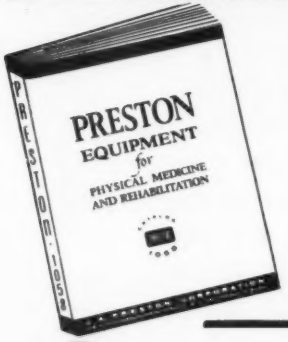

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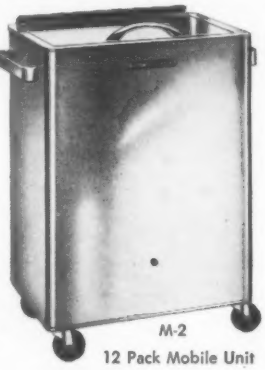

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Surgical Considerations of Hand Rehabilitation

John L. Bell, M.D.
Chicago

● The anatomy and kinesiology of the hand will be reviewed from the standpoint of diagnosis and management of acute injuries and reconstructive surgery of the hand. In the main, there are three types of injuries to the hand; sharp lacerations involving tendons and nerves; crushing injuries which involve not only the covering tissues, but may involve bones, joints, tendons and nerves; and lastly, thermal burns of the hand. Although skilled primary care may obviate the necessity for additional reparative procedures in many types of trauma to the hand, crushing injuries are frequent exceptions. In the latter an optimum restoration of function is accomplished only after one or more secondary operations, even though the initial wounds may have healed without infection, tissue necrosis, or excessive scarring. If these disastrous conditions have intervened, problems of reconstruction are compounded and the ultimate result is far from satisfactory. It is well recognized that adequate, early initial surgery is the foremost deterrent to these complications following mutilating trauma of the hand. Crushing injuries vary in extent, depth and location. Frequently more than one type of tissue is involved. However, covering tissues of the hand are most commonly damaged in open crush injuries. Deeper structures which should be considered are tendons, nerves, intrinsic muscles, bones and joints. To determine its efficiency, the injured hand should be re-evaluated when all wounds are soundly healed. A knowledge of anatomy and basic functions of the hand is essential to assess properly all situations encountered following maximum healing of tissues. Although secondary procedures may have been anticipated from the time of initial surgery, some may not be necessary following a reasonable trial of time and use. Loss of sensation may be a greater disability than loss of active motion. Stability with intact sensation is often more useful than active movement in a digit which lacks feeling. Mobility of stiffened interphalangeal joints cannot be corrected satisfactorily by surgical methods; however, motion at metacarpophalangeal joints often is improved following lateral capsulotomies. Loss of function after irreparable destruction or long standing paralysis of intrinsic muscles may be partially overcome, if joint mobility has been preserved along with sufficient motor components which can be utilized for substitution. Following tendon injuries, an increase in active extension or flexion of digits is possible, provided that intervening joints and surrounding tissues permit either secondary repair or tendon grafting as necessary. In many instances the problems of reconstruction to provide even minimal restoration of function may be complex.

The initial care of the acute injury is the first important step in rehabilitation after trauma to the hand. In many instances, early, adequate wound treatment may be definitive, but in others it is simply a preliminary stage of reconstructive surgery. Formation of excessive scar tissue is the greatest enemy to achieving functional end results in surgery of the hand. The surgeon must be constantly aware of factors which favor excess scarring, namely, infection, hemorrhage, dead tissue, foreign bodies, and edema. The guiding principle in the treatment of all acute hand wounds is the necessity to secure healing without infection and with minimal inflammatory reaction.

Three types of open injuries should be differentiated: sharp lacerations, crushing wounds, and burns. Each type has certain features which influence the management and clinical course. Rank and Wakefield[1] have conveniently divided mechanical injuries into "tidy" and "untidy" wounds. Most household accidents with knives or glass are "tidy." Tissue damage is confined closely to the path of the wounding agent, and tendon or nerve division is common. "Untidy" wounds are caused by industrial and farm machinery, power tools at home, explosions, and gunshots. These injuries are characterized by widespread destruction of tissue and frequent fractures. Skin losses and avulsed flaps are common and often present a greater problem than injury to deeper structures. Burns of the hand vary in extent and depth. The amount of functional return is dependent upon two factors: the severity of thermal damage and the interval between burning and complete healing. The treatment of acute burns of the hand differs from the treatment of mechanical injuries in that primary removal of devitalized tissues can be only rarely achieved because of the inherent difficulty in accurately assessing the depth of the burn when first seen.

The surgeon who first treats an acutely injured hand should try to envisage the phases through which the hand must pass before maximum function can be attained. A knowledge and understanding of normal function and anatomy of the hand is essential to assess the tissue damage and plan functional restoration. It should be emphasized that anatomical restoration and functional restoration are not necessarily synonymous. The extent of the initial surgical treatment of the wound will depend upon the nature of

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the injury and the circumstances surrounding it. Primary wound healing is the prime objective of initial surgery. Unless it can be anticipated anatomical restoration of tendons and nerves should be postponed. The difficulties of later reconstructive procedures are increased if initial tendon and nerve repairs fail due to disturbed healing.

Treatment of Acute Injuries

The principles involved in the treatment of acute hand injuries differ little from those which apply to all open wounds, regardless of location.[2] An accurate history and preoperative examination are the first steps in appraisal of a patient with a hand injury. The history helps to determine the probable degree of contamination and the amount of tissue damage. Examination of the wound to establish a working diagnosis must precede operative care in every case. The wound should not be probed under any circumstances. Aseptic precautions are essential during any inspection of the wound. Secondary contamination by virulent pathogens is often a greater factor in the development of infection than the initial bacterial inocculation of the wound. In sharp or "tidy" wounds the presence of nerve or tendon injury may be diagnosed by a few routine tests for motion and sensation without disturbing the wound. By contrast, damage in "untidy" injuries cannot be accurately assessed until the patient has been anesthetized and the wound cleansed. In these injuries x-ray examination for fractures and dislocations should be part of the preoperative preparation of the patient. General examination of the patient may reveal other injuries which demand priority in care. The medical history should be obtained, especially for those patients who will require general anesthesia.

A tentative plan of care should be outlined prior to primary operative treatment. If immediate functional restoration is not feasible, the surgeon should plan this initial operative procedure so as to prepare for the necessary reparative operations as soon as the wounds are soundly healed.

Wound Excision. Certain steps in the operative procedure must be followed in orderly fashion. Before the operation can be undertaken, however, the wound has to be converted into a clean surgical wound. This is accomplished by careful, thorough cleansing of the hand, followed by gentle wound cleansing and irrigation with physiologic saline solution. Antiseptic agents have no part in the cleansing process. Excision of devitalized tissue is the first step in the operative procedure. "Tidy" lacerated wounds require little or no excision of tissue; however, crushing or "untidy" injuries may demand extensive excision to rid the wound of devitalized tissue or tissues destined to become necrotic. "En bloc" excision is not applicable for hand injuries. If any tissue is obviously lifeless it must be removed, but needless sacrifice of tissue has to be avoided. Control of bleeding is an important part of the wound excision or debridement.

The viability of each type of tissue encountered during the procedure has to be assessed. Skin excision must be most carefully performed since every viable tag may be useful for closure. Flaps of skin which are severely crushed, whose vessels are thrombosed, or which are deprived of blood supply should not be saved. Although muscle excision is seldom extensive in the hand, obviously devitalized muscle must be excised. Nerve and tendon excision should be kept at a minimum. In crushing injuries the only absolute indication for the amputation of digits is nonviability.

Deep Repair. After adequate excision of devitalized tissue a decision must be made concerning the feasibility of the repair of deep structures. It is at this phase that the nature and circumstances of the injury and the surgeon's judgment influence the course of the procedure. Fractures and dislocations have to be reduced and maintained, but to repair nerves and tendons requires more consideration and the exercise of sound judgment. Tendon or nerve repair should not be considered in any wound in which there is a doubt as to primary wound healing.

A history of severe primary or secondary contamination is a contraindica-

tion to nerve and tendon repair. Tendon repair is seldom permissible in crushing injuries because of the lowered vitality of tissue over a widespread area, for it is essential that the sites of repair be covered with normal skin and subcutaneous tissue.

Flexor tendon injuries and open fractures usually preclude tendon repair. Maintenance of accurate reduction of the fracture and union of the flexor tendon cannot be simultaneously achieved, because of the incongruous positions required for each. In some instances, however, severed extensor tendons may be sutured over fracture sites without disturbing the position of the fracture.

The facilities for repair and the capability of the surgeon are other factors which cannot be overlooked. Proper equipment, suture material, adequate anesthesia, and good lighting are needed. Unless the minute details of atraumatic technic are well understood, primary tendon or nerve approximation should not be attempted.

Nerve Repairs. Properly performed primary nerve repairs in the hand and wrist seem to offer better end results than secondary or delayed sutures. Few hand surgeons question the advisability of primary nerve repair in the neatly incised wound seen within the first few hours after injury. The preoperative diagnosis is easily established by testing for sensation and intrinsic motions of the hand. The ninhydrin printing test described by Moberg[3] can be used in children unable to cooperate with the examiner.

Digital nerves should be repaired in all wounds except those frankly infected or with great loss of substance, making approximation impossible.[4] Primary repair of the median nerve in the proximal palm may be extremely difficult if the surgeon is confronted with several distal branches and one proximal trunk; however, secondary sutures in this location are more tedious and far less satisfactory. In many secondary repairs it is almost impossible to reunite a divided median motor branch satisfactorily, and there is often considerable disparity in size of nerve ends following removal of the proximal neuroma and scarring of the distal stump. The ulnar motor branch may be difficult to repair secondarily.

Primary approximation of neatly severed nerves can be accomplished without marked flexion of the hand and digits to relieve tension on the suture line. Extensive proximal and distal dissections to free the nerves for apposition is seldom necessary in primary repairs. This contrasts with the frequent necessity for rerouting a nerve to overcome a long gap caused by scarring and retraction during the interval between the injury and secondary suture. The blood supply of a sharply divided nerve is rarely jeopardized while primary repair is being performed, but in secondary repairs it may be necessary to dissect the nerve from enveloping scar tissue and thereby disturb its vascularity. Lastly, little or no trimming of nerve ends is necessary and an anatomical end-to-end approximation is usually possible. In many secondary repairs it is difficult to properly align the cut ends following resection of scar and neuroma.

Tendon Repairs. With the exception of one location on the flexor surface, most experienced hand surgeons agree that primary tendon repair should be performed if none of the aforementioned contraindications are present. In the sharp wound an accurate end-to-end apposition of tendons can be obtained with proper technics. It should be recalled that the proximal ends of severed flexor tendons retract further than proximal extensor tendon stumps. Accessory incisions or extensions of the original wounds are usually necessary to gain access to the divided structures in either flexor or extensor tendon injuries. When planning an incision or enlarging the wound, the surgeon should avoid crossing flexion creases at right angles. Such incisions and cruciate enlargements of transverse wounds often lead to disabling contractures and to failure of the primary surgery.[4]

Injuries to the flexor tendons are divided into several zones because of the variable situations met when tendons are severed at different levels. The first zone covers that portion of the profundus tendon in the finger distal to the sublimis

insertion on the middle phalanx. In this location the profundus tendon is alone in the sheath, and if it is severed it may be advanced and sutured to the distal stump. It is essential to excise the overlying fibrous sheath to permit an adequate blood supply to the sutured ends.

The second zone is more proximal and has been called the critical area, or "no-man's land." In this zone, the two sublimis slips and the profundus tendon are encased in the fibrous sheath which begins at the level of the metacarpophalangeal joint in the palm. The distal border of this zone is at the base of the middle phalanx at the level of the sublimis insertion. It is in this zone that the greatest problems are encountered, both initially and secondarily. The majority of hand surgeons do not advocate primary tendon repairs in this location because of the high incidence of poor results. Furthermore, initial failures in this area jeopardize the chances for functional return even though later tendon grafting is performed.

Some hand surgeons believe that primary repair may be undertaken, but only when certain criteria are strictly observed. The wound must be neatly incised, the contamination very slight, and the time since injury not more than four hours, and preferably less than two hours. In a very occasional case the profundus alone is severed in this area and the sublimis remains intact. In the event of this finding, primary repair of the severed profundus tendon is contraindicated since it is a well-established principle that the function of an intact sublimis tendon should not be sacrificed. If both tendons are divided and primary repair is considered, the sublimis tendon is removed from the digit and the profundus tendon is repaired. It is necessary to remove a generous portion of the overlying tendon sheath to permit adequate vascularity at the site of the sutured profundus tendon. Because of the lack of understanding of the problems in this location, it is often better to cleanse and close the skin wound and undertake reconstruction at a later time. The question of primary repair in this area remains unsolved at the present time, and further clinical and experimental studies are needed before the answers will be known.

Good results may be expected following primary repairs in the palm. There is an excellent blood supply at the site of suture and an abundance of surrounding areolar tissue. Both the sublimis and profundus tendons are usually repaired at this level. Division of flexor tendons within the carpal tunnel should be repaired initially if at all possible, for the results of secondary reconstructive procedures are much less successful, because of the marked retraction of the proximal stumps. When the suture sites lie in this region it is usually advisable to suture the profundus tendons and omit sublimis tendon repair. The carpal ligament and sublimis tendons are not approximated because of the lack of space available for healing without marked fibrosis.

Every effort should be made to perform primary tendon and nerve repair in the wrist and lower forearm. The functional results following a well-performed initial procedure far surpass those obtained in any secondary reconstruction at this level, since secondary deformities, muscle retraction, and dense fibrosis are difficult to overcome. It must be remembered that in any flexor tendon injury there is a strong likelihood that an accompanying nerve is also severed and has to be repaired. Suture of a divided flexor pollicis longus tendon usually achieves a more satisfactory result than repair of tendons in the fingers.

The extensor tendons can usually be sutured primarily if soft tissue coverage is adequate over the site of repair. If these tendons are cut within the synovial sheaths over the dorsum of the wrist, the proximal stumps retract into the forearm and repair at this location is difficult. When the injury is distal to the synovial sheaths, very little retraction occurs and the divided ends may be approximated without the extensive exposures that are necessary on the flexor surface. At times it is possible to obtain union of extensor tendon ends without suturing. When the injury is over the phalanx or in the region of the metacarpal heads, these tendons may heal spontaneously if the part is kept

splinted long enough; however, accurate approximation by sutures is advisable.

Fractures and Joint Injuries. Dislocations have to be reduced and maintained, and open joints must be closed. Fractures are reduced at the initial operation. Frequently it is possible to maintain reduction by splinting the hand or digit in a functional position, but for many open fractures internal fixation of bone fragments offers better functional results.[5] Fine steel sutures, screws, or Kirshner wires are commonly used for fixation. Skeletal traction, however, is seldom necessary in the treatment of fractures of the hand. Fingers should not be immobilized in extension because of the deleterious effects upon joints which may become fibrosed and permanently immovable. With adequate fixation of fractures, the hand can be held in a functional position, and only those parts necessary to maintain reduction are splinted.

Closure of Wounds. Closure of the wound is one of the objectives of the initial operation. An open wound is susceptible to infection. As days pass by, the closure becomes more difficult even in the absence of gross suppuration. For most civilian injuries primary closure is indicated in wounds treated within the first 8 to 10 hours after injury, in which adequate removal of devitalized tissue has been achieved, and in which severe primary or secondary contamination is minimal. In wounds treated 12 to 24 hours after injury in which no primary cleansing or excision has been performed, a thorough cleansing and debridement is carried out, but deep repairs are omitted. Closure may then be performed, if gross infection is absent, after 4 days have elapsed.

No skin can fully compensate for a loss of normal hand skin, and for this reason every viable skin tag should be saved at the time of wound excision. It is difficult to overcome a void of volar skin by undermining and suture without tension, but this technic can often be used over the dorsum of the metacarpal region. When skin losses are too great to permit suture without tension, the application of skin flaps or free skin grafts must be considered.

Split-thickness skin grafts are most commonly used initially. The thickness of the graft will depend on the vascularity of the surface. Any free skin graft cannot be expected to take over tendon, bone, or joints completely denuded of overlying areolar tissue. On rare occasions in which a skin defect results from a sharp injury without a crushing element, a free full-thickness graft may be considered primarily. Full-thickness grafts are more applicable in secondary procedures, particularly following excision of scar contractures on the volar aspect of the hand.

When bones, bare tendons, joints, and nerves are exposed, a flap of skin and subcutaneous tissue is mandatory for protection of these structures. Rotation flaps should be used if at all possible. The flap covers the traumatic defect and the donor area of the flap is closed with a partial-thickness graft. Pedicled flaps from distant areas are avoided if possible as a primary procedure; however, in some circumstances only a pedicled flap will permit closure and protection of deep structures.

The cross-finger flap has been very useful to cover deep defects over the volar aspect of the fingers in instances where free grafts or rotation flaps cannot be used. The dorsal digital skin is well vascularized, and large flaps can be raised and immediately transferred to the adjacent digit. The donor area is closed with a free skin graft. If the defect is too large, a pedicled abdominal or chest flap may have to be used. These flaps have to be well designed to cover all the area of tissue loss and permit wound inspection and dressing changes. The pocket flap is only rarely considered or necessary.

Dressings and Aftercare. An integral part of the operation is the application of a suitable dressing. Compression dressings and splints are valuable adjuncts to a carefully performed procedure. A properly applied dressing deters venous congestion and edema. It controls capillary oozing but is not a substitute for careful hemostasis. Digits should always be separated by gauze to avoid maceration. The

dressing must not constrict the hand or cause pressure over bony prominences. For crushing injuries, burns, and fractures, the hand is placed on a splint in the position of function. When nerve or tendon repair has been performed, the hand has to be positioned so that forearm muscles are relaxed in order to prevent tension on suture lines. Flexor tendon and nerve repair require flexion of the hand at the wrist. In extensor tendon repairs the hand is extended at the wrist. Hyperextension of the proximal phalanges at metacarpophalangeal joints should be avoided because of the tendency for the development of severe contractures of the joint capsules. Elevation of the extremity, rest of the injured part, and the intelligent use of dressings are essential to the ultimate result. Shoulder and arm exercises should always be prescribed for the patient who wears a sling.

The first postoperative dressing change usually takes place after four or five days. Inspection of the wound is important at this time to detect any evidence of maceration or tight sutures. The position of the hand need not be disturbed. Sutures are removed between the sixth and tenth day following operation. It takes three weeks of immobilization following flexor tendon and nerve repair, but extensor tendons are immobilized for an additional week.

The patient is encouraged to use his hand when healing is sound. He is instructed and supervised in the active use of his atrophied forearm muscles. Hand soaks and washing in warm soapy water are prescribed to encourage circulation and help mobilize stiffened joints. Passive exercises are of little value and if administered too vigorously may result in tearing of tissues with a subsequent increase in scarring.

Secondary Reconstruction

To determine its efficiency, the injured hand should be evaluated when wounds are soundly healed, inflammatory reaction has subsided, and maximum joint mobility is attained. Although skilled primary care may eliminate the need for additional reparative procedures in many cases, the goal of optimum functional restoration may require one or more secondary operations.[5] In "untidy" injuries the primary operation is many times the first stage of reconstructive surgery. For some sharp injuries involving the flexor tendons within digital sheaths, the initial wound surgery is the first step toward restoration of function, for if surface healing by primary intention can be achieved, tendon grafting will be permissible as early as three weeks following injury.

It is not possible to completely review the subject of reconstructive procedures for hand injuries; however, some remarks should be made concerning correction of scar contractures, secondary tendon and nerve restoration, treatment of joint disabilities, and substitution procedures for irreversible paralysis. To be most useful, the hand must have sensation, mobility, and power. The return of useful grasp, pinch, and the ability to feel are the main objectives of the procedures. A stable skeletal framework and adequate covering tissues are prerequisites for secondary tendon and nerve repairs.

Scar Tissue Correction. Wounds which heal by secondary intention account for the majority of scar disabilities in the hand, but a wound whose direction is "against the grain" may cause contracture even though first-intention healing has occurred. Scarring may involve the skin alone, or may extend into depths of the hand surrounding joints, tendons, and nerves. It must be remembered that forceful manipulations of scars only result in tearing and further scarring.

Superficial or cutaneous scars may be either linear or broad. Narrow linear scars which lead to contraction are often corrected by "Z-plasty" because there is no great loss of skin to overcome. When scars follow skin loss, the defect following scar excision has to be covered with a skin graft. Full-thickness grafts are preferred for the volar aspect of the hand whenever possible. These grafts do not contract and have a better return of sensation. Split-thickness grafts are usually used for replacement of extensive defects on dorsal surfaces. In children's hands, scar replacement with partial thickness

grafts may be followed by another contracture since the split graft does not keep pace with the rapid growth rate of the surrounding normal skin. Careful attention to every detail must be given to assure a complete take of free grafts. Hematomas or infection may result in poor takes, which may increase the disability.

If scarring is deep and excision uncovers nerves or bares tendons, joints, or bone, a free graft will not suffice to cover the defect. In the first place, these structures do not provide a suitable vascular bed for acceptance of a graft. Secondly, tendons, nerves, and joints have to be surrounded by areolar tissue in order to function. It is in this type of case that a flap of skin and subcutaneous tissue is required.

If extensive scarring is associated with damage to deep structures, the scar has to be excised before repair can be undertaken. For small areas, a local flap may be available, but for large areas a distant pedicled flap is necessary. In some instances it may be possible to graft a bone defect when a pedicle flap is applied, but tendon grafting has to be postponed until healing has occurred and joint mobility is restored.

Painful amputation stumps may be caused by the adherence of digital nerves to the scarred area or inadequate soft tissue padding over the bone. In either case a revision of the stump is necessary to afford relief of the pain which may reduce the function of the rest of the hand. Soft tissue has to be provided over every nerve resection or repair.

Secondary Tendon Repair. The essential requirements for secondary tendon restorations are functional muscle-tendon units and mobile joints. In some locations and with certain circumstances, direct secondary suture may be performed, but in other situations tendon grafts or transfers are necessary to achieve functional results. The interval between the injury and secondary repair has a definite influence upon the choice of procedures. In long-standing lesions retraction may be irreversible. For such cases a graft is required to overcome the loss of length, and a functioning muscle is required for activation. In recent lesions, usually less than one year, sufficient muscle power is retained to function as a motor unit. If this is the case, direct suture may be possible except for certain regions or the intervention of sepsis and excessive scarring.

It is frequently possible to perform secondary flexor tendon sutures in the proximal palm and wrist following neatly incised injuries which are of recent origin. If the suture line lies within the carpal tunnel, the profundus tendons are sutured and the sublimis tendons are excised. The technic of approximation is usually the same as that used in primary repairs. The repair of divided nerves has to be undertaken at the same time. Secondary suture of the profundus tendon distal to the sublimis insertion in the digit may be possible if the tendon can be advanced to the distal phalanx. If the profundus cannot be advanced, some surgeons prefer to stabilize the distal phalanx by tenodesis or arthrodesis, but others advocate the use of a tendon graft through the digit. This problem has not been solved to everyone's satisfaction; however, both groups adhere to the principle of saving a functional sublimis tendon.

A lesion located within "no-man's land" is an absolute contraindication to secondary suture. A tendon graft must be used in this location to replace the profundus tendon, and the injured sublimis tendon has to be removed from the digit. Boyes[6] has shown that the best results in digital grafts were obtained when there was no attempt at primary tendon suture, joints were supple, scarring minimal, and neurovascular bundles were intact. The palmaris longus tendon or a long extensor of a toe is used as the tendon graft. If the lesion is in the thumb, secondary suture is possible only at the level of the distal phalanx. A tendon graft extending from the lower forearm to the distal phalanx is used when the site of division lies in the thenar area or over the proximal phalanx of the thumb.

Secondary extensor tendon repairs in the region of the metacarpophalangeal joints differ little from primary sutures,

but restorations within the synovial sheaths on the dorsum of the wrist are difficult to achieve. Grafting or substitution technics are often required in these injuries. Secondary suture of the extensor pollicis longus tendon over the phalanges is usually possible, but when the lesion is proximal a tendon transfer is usually needed because of marked retraction of the proximal stump. The extensor indicis proprius transference for this injury is the procedure of choice.

The "baseball" or "mallet" finger injury is caused by either rupture, open cutting, or avulsion-fracture of the extensor tendon insertion from the distal phalanx. In lesions seen within four to six weeks after injury there is a good chance for functional return by splinting alone; however, later cases require secondary operations. These injuries have been treated by many technics and no final solution has yet been reached. Direct end-to-end suture is not always possible because of the lack of available tendon tissue. Tendon grafts are sometimes used to overcome the paucity of tendon.

There are many technics for secondary restoration of the deformity resulting from an old division or rupture of the central extensor slip over the proximal phalanx. Two abnormalities have to be corrected: (1) the disruption in continuity of the central slip, (2) the volar displacement of the lateral slips. Tendon grafting may be necessary in many instances. Long-standing injuries may be complicated by joint changes which cannot be overcome by surgical methods.

Secondary Nerve Suture. Secondary nerve suture depends upon the ability to mobilize the divided nerve stumps in such a way that accurate approximation can be performed without tension on the suture line. It is not always possible to overcome long gaps by dissection and postural changes. Rerouting the nerve may be required to bring the ends together, and in some cases nerve grafting has to be considered in order to restore continuity. However, the value of nerve grafts is difficult to appraise.

In recent sharp injuries secondary sutures achieve satisfactory functional results. In long-standing lesions the return of function is less hopeful, especially when severe muscle atrophy, trophic changes, and joint deformities have taken place. Some return of sensation after accurate repair is of extreme value even in old cases, in which there is no likelihood for motor recovery.

The surgeon has to be familiar with the technics of rerouting nerves to gain length. Transfer of the ulnar nerve anterior to the medial epicondyle of the humerus is a well-established method. Additional length may be attained for the median nerve by bringing it anterior to the pronator teres muscle. Rerouting the ulnar nerve at the wrist is helpful in secondary motor branch repairs. When these methods fail, the proximal neuroma can be sutured to the distal scarred end and the extremity placed in a relaxed position. After three to four weeks, the extremity is gradually extended and the nerves are thereby lengthened. On later reoperation it may be possible to resect the scars and perform an acceptable suture.

Joint Disabilities. Mobility of stiffened interphalangeal joints cannot be restored satisfactorily by arthroplasties; however, motion at metacarpophalangeal joints may be regained after lateral capsulotomies. Numerous experimental studies and clinical trials are being performed to help solve the problem of intractable deformities following direct injuries to joints, but no solution has been found at the present time. Joint stiffness from improper immobilization procedures is better prevented than treated by any method. Arthrodesis of interphalangeal joints may partially overcome extreme flexion or hyperextension deformities or instabilities; however, fusion of a metacarpophalangeal joint of a finger should not be considered, regardless of its deformity, as long as some motion is present.

Substitution Procedures For Paralysis. Tendon transfers are carried out for either irreparable nerve lesions or nerve repairs which have failed. The operation for irreparable radial nerve paralysis consists of supplying motor tendons for extension of the digits and providing either stability of the wrist or active extension if at all possible. In intrinsic median

paralysis, rotation of the thumb may often be obtained by transfer of a sublimis tendon to the region of the metacarpophalangeal joint. The deformities from interosseus muscle paralysis may be partially overcome by tendon transfer if the interphalangeal joints are mobile. Sublimis tendons are split longitudinally and can be passed through the lumbrical canals to the extensor expansions. If successful, this procedure will permit active extension of the phalanges.

References

1. Rank, B. K., and Wakefield, A. R.: Surgery of Repair as Applied to Hand Injuries, Baltimore, Williams & Wilkins Company, 1953.
2. Early Care of Acute Soft Tissue Injuries, Committee on Trauma, American College of Surgeons, Chicago, American College of Surgeons, 1954.
3. Moberg, E.: Objective Methods for Determining Functional Value of Sensibility in Hand. J. Bone & Joint Surg. **40-B**:454 (Aug.) 1958.
4. Mason, M. L., and Bell, J. L.: Treatment of Open Injuries to Hand. Surg. Clin. North America **36**:1337 (Oct.) 1956.
5. Mason, M. L., and Bell, J. L.: The Crushed Hand. Clin. Orthop. **13**:84, 1959.
6. Boyes, J. H.: Flexor-Tendon Grafts in Fingers and Thumb: Evaluation of End Results. J. Bone & Joint Surg. **32-A**:489 (July) 1950.

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Evaluation and Treatment of Lower Motor Unit Lesions Involving the Shoulder, Arm, Forearm, and Hand

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● The physician who accepts the responsibility of caring for a patient with muscle weakness following a lower motor neuron lesion must understand the reaction of the motor unit to disease and trauma, and must have the ability to determine the site and extent of the lesion so that he can precisely prescribe and personally treat, or supervise the treatment of, his patients. Diagnosis must be based on an accurate history and specific objective findings. These findings are obtained through observation of bodily movement, specific muscle strength testing, and electronic analysis of motor unit function. The program of care is based on the apparent contradiction that while full recovery is expected something less than full recovery is anticipated. With this basis in mind, the technics and devices used to promote recovery must in no way limit the possibilities of functional devices and orthopedic surgery if full recovery does not take place. In general, the treatment program is made up of four components: (1) proper support of weakened bodily segments; (2) intelligent mobilization; (3) specific muscle reeducation, and (4) specialized functional analysis and training with or without specialized orthetic devices and modified environment consistent with the site and degree of residual weakness.

The physician who accepts the responsibility for evaluating and treating a patient with muscle weakness must also be able to establish or confirm the probable cause of the lower motor unit dysfunction. While the physiatrist is most commonly called upon to handle such problems as poliomyelitis, chronic neuronitis, and peripheral nerve injuries, he must be aware of the characteristics of polymyositis and the primary myopathies; myasthenia gravis; the neuropathies of lead and arsenic poisoning and diabetes; the weaknesses of glandular diseases such as hyperthyroidism, hyperparathyroidism, and Addison's disease; the weird demyelinating diseases; porphyria, and many others that do not come immediately to mind. The only purpose in listing some of the conditions responsible for muscular weakness is to make us all realize that the diagnosis and the prognosis may depend not only on the tools of physical medicine, but frequently on the data obtained from muscle biopsies, x-rays, clinical analysis of blood and urine, and alterations of strength following the use of drugs.

Evaluation of the Disability

An accurate evaluation of the site and degree of muscle weakness is required to aid in establishing a diagnosis, to provide a basis for treatment at all stages of convalescence and chronicity, to determine the rate and extent of recovery, and to determine the prognosis. Only certain physical methods of evaluation will be discussed here. The accuracy of these methods is directly proportional to the physician's working knowledge of functional anatomy, his ability to accurately record his findings, his understanding of the influence of altered proprioceptive sensation on muscular activity, and his appreciation of the value and limitations of data gained through electronic methods of muscle analysis.

Gross Physical Examination. After the history is obtained and available data is noted, the physiatrist's evaluation begins by having the patient attempt to move the involved bodily segments in all of the planes normal to these segments. Resistance may be added to these movements. Movements in other bodily segments, presumably uninvolved, should be noted. Frequently, an accurate evaluation of strength, coordination, endurance, and mobility can be obtained without the physician actually touching the patient at all. It is quite simple to pick up isolated weaknesses, as in the serratus, deltoid, biceps, extrinsic finger extensors, and intrinsic muscles of the fingers and thumb. However, the main reason for watching the patient perform gross movements is to determine the presence of dyskinetic movements that would indicate nuclear or pathway lesions above the lower motor unit, and to pick up the inconsistent patterns of the untrained malingerer.

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Executive Director, Georgia Warm Springs Foundation.

Analysis of the site and degree of muscle weakness cannot be determined with any degree of accuracy by observation of gross movements alone. Accuracy requires manual muscle testing and usually electronic sampling of all muscles in the extremity involved as well as spot-checking of those muscular areas presumably uninvolved.

Manual Muscle-Strength Testing. Manual muscle-strength testing is the most valuable single aid to diagnosis, prognosis, and treatment that we have in dealing with lower motor neuron involvement. The physician can test the relative strength, coordination, and endurance of all important muscles of the upper extremity, can record this data, and can repeat these tests at intervals to give valid data on which to base prognosis and treatment. This is true only if, first, the patient is not consciously trying to mislead the physician (age or intelligence that might limit the concentration and cooperation of the patient simply requires a longer period of time or several attempts before the tests can be completed); and second, if the physician follows a standard routine of testing and grading based on accurate functional anatomy. Several different routines of testing and grading are in common use today, and many physicians have their own methods. The only advantage of using a universal system is that other physicians, and therapists, can properly interpret the tests when necessary.

Manual muscle testing does not require that one muscle alone contract. Obviously, this is not possible unless all but one muscle is denervated. The standard procedures of testing attempt to so place and stabilize bodily segments that the activities requested of the patient enable the physician to visualize or feel the use of certain muscle fibers in their most effective position or plane of motion. It should be obvious that this requires a great deal of skill, particularly when weakness, marked muscle imbalance, or skeletal deformity exist in the segments being tested. No one should think that a manual test is easy to make, and no physician must entrust this test to anyone else if critical decisions are to be based on the results.

The personal performance of the test is important for another reason. The manner in which a muscle contracts frequently suggests the diagnosis, and may also indicate to the physician that a valid test cannot be recorded in specific grades of strength. The physician develops skill in feeling abnormalities of muscular contraction that are somewhat difficult to describe in words. The patient with anterior poliomyelitis, or with a peripheral nerve injury resulting in a conduction block, attempts to contract the partially denervated muscle in every way possible and the result is usually a fairly well-sustained, though weak contraction. The contraction is sustained even if the muscle is gradually stretched out by a force too great for it to hold against.

Repeated attempts result in contractions of similar strength until the muscle tires. If the contraction is poorly sustained, jerky, or "cogwheel" in type, or if the strength of contraction varies haphazardly, the possibilities of a peripheral demyelinating disease, a disturbance of proprioceptive sensation, a "functional" disease, or outright malingering must be considered. In polymyositis the initial contraction may be slow to develop and there may be wide variations in strength, but the jerky cogwheel type of contraction which may be present is not as marked, although I must admit that I have mistaken polymyositis for malingering on several occasions. In myasthenia the contraction is well sustained but becomes weaker as repeated contractions are made. In myotonia the contraction develops rapidly but relaxation following contraction is slow.

Hysteria and malingering have many guises. The most common response is a slow and apparently laborious contraction that relaxes suddenly and starts over again with added expressions of great effort. Even the slightest manual resistance results in immediate relaxation. Patterns of gross movement are bizarre, inconsistent, and cannot be explained on any known pattern of actual weakness. The malingerer is frequently trapped

into using muscles that he apparently cannot use by observing their action in associated movements. However, it must be pointed out that the inability to use a specific muscle when requested, coupled with the obvious use of that muscle during other movements, does not rule out organic disease.

While muscle-strength testing reveals the site and extent of changes in the patient's voluntary control of his skeletal musculature, it can only suggest the changes taking place in the various components of the lower motor unit. As mentioned previously, muscle biopsy, chemical analysis of blood and urine, and changes in strength following the use of certain drugs may be necessary for diagnosis and for extensive analysis.

Electronic Evaluation. Electronic evaluation of nerve and muscle damage has become an important and an essential part of physiatric examination. These tests, when properly done, will give a quantitative analysis of the site and extent of damage to the lower motor unit. Basically, these tests fall into two groups: first, neuromuscular stimulation by electrical currents, and, second, electromyography. Little need be said about neuromuscular stimulation; physicians have been using these tests for many years, and the apparatus required is commonly available. These tests are based on the knowledge, first, that muscle tissue can be made to contract by stimulating the muscle directly, or the muscle through its motor nerve, with an electrical current; and second, that innervated muscle is normally far more sensitive than is denervated muscle to this form of stimulation.

Many tests of this type have been devised, but in this country only three are in widespread use. These are, first, the reaction of degeneration; second, the strength-duration curve; and third, the determination of chronaxie. Of this group, my practice seldom requires more than the use of chronaxie determination. As is well known, chronaxie is simply an arbitrary point on a strength-duration curve and may be defined as the time required for an impulse of twice the rheobase to cause a minimal contraction in the muscle under study. Normal values of chronaxie have been determined and are easily available, and these are compared to determine the degree of denervation in the muscle under study. The chronaxie value can never be as completely informative and reliable as visualization of the entire strength-duration curve, of which chronaxie is but one part. Chronaxie does have the value of giving the physician a single figure that can be recorded and can be compared to a normal figure, rather than requiring that a curve be plotted and interpreted.

Electromyography has become increasingly important in the analysis of muscle function. This is a method of electrodiagnosis capable of analyzing the integrity of the lower motor units by amplifying and recording the electrical activity of a muscle fiber immediately preceding contraction. The variations in electropotential can be visualized on a cathode ray oscilloscope and recorded by a still or moving picture camera, and they can be heard through a loud speaker and recorded on a tape recorder. Gross analysis of many superficial motor units can be obtained by small electrodes placed on the skin over the muscle to be tested. This method is not commonly used, as far more precise information can be gained by inserting a needle electrode directly into the muscle. In this manner the electrical activity of a single muscle fiber can be studied. Multiple sampling through a muscle is required for adequate study. Normal muscle shows no electrical activity when the muscle is at rest, and an easily identified "nerve potential" activity when voluntarily contracted. When a motor unit is damaged, electrical activity may be noted even when the muscle is at rest, and attempts to contract the muscle may show complete electrical silence, abnormally formed potentials, or the characteristic "fibrillation potential" of complete muscle fiber denervation.

It must be emphasized, however, that the electromyograph does not give a clinical diagnosis. However, with adequate exploration of muscle tissue and

accurate interpretation of the recorded data it is possible to:

1. Determine positively if organic denervation exists, even if the clinical diagnosis is complicated by such factors as pain, hysteria, malingering, or disuse atrophy.
2. Map out the physical extent of denervation, not only in terms of muscles supplied by cord levels, plexus roots, or peripheral nerves, but also the extent and pattern of denervation within a single muscle.
3. Usually distinguish between primary muscle disease and nuclear disease.
4. Recognize evidence of reinnervation before any clinical change is evident.

Obtaining and interpreting electromyographic data require a high degree of skill and experience. The test must be meticulously done. It is tedious and time consuming, and can only be considered valid if done by a well-trained and experienced individual.

Treatment

For the sake of simplicity of discussion, the treatment of nerve damage may be divided into three parts: medical, physical, and rehabilitative. In actual practice this must never be done, except in very mild problems, as there is no sharp line dividing these three components of adequate care, either on a chronological or medical specialty basis. If the disease is mild and quickly reversible, the problem can be handled by any experienced and responsible physician. If the damage is extensive and likely to be irreversible to some degree and has the possibility of long duration, it will require the combined efforts of many disciplines, both medical and paramedical, working together from early convalescence until all possible recovery has taken place. To assure this early concerted effort, the treatment program from the beginning is based on two seemingly contradictory premises.

1. The patient will recover completely if given proper care.
2. The patient may not recover completely and must be prepared physically, psychologically, and vocationally to intelligently adjust to his eventual disability.

Fortunately, under this plan the patient will receive the best of care. Care designed for complete recovery will be directed at the disease itself and the physical by-products of muscle weakness that might limit complete recovery. These, of course, are the same physical by-products (for example, contractures, skeletal distortion, and muscle imbalance) that complicate the chronically disabled and limit the possibilities of safe and practical physical activity despite residual weakness. Care designed to assist the patient to intelligently adjust to some degree of ultimate physical limitation will utilize the long period of convalescence, not only for treatment of a disease entity, but also for evaluation of the patient as a person, whether he be child or adult, who must eventually return to a normal environment, and must be prepared to contact and to compete with physically normal individuals.

If nerve damage can neither be prevented nor cured by specific medical care, the care of the residual involvement must emphasize forms of treatment designed to assure maximum recovery of physical capacity within the limits of irreversible pathology. For all practical purposes, this amounts to taking what is left of the nervous system after the acute stage of the illness is over and making it function as effectively and efficiently as possible. To this end, physical medicine must:

1. Stimulate and guide recovery of muscle strength and balance.
2. Minimize changes in bodily tissue that complicate muscle weakness or imbalance of muscle strength.
3. Provide orthetic devices that not only may be essential to the achievement of the other two objectives, but may also be necessary to support and assist safe, functional activity if recovery is limited.

Muscle Re-education. Muscle re-education is the traditional term used to designate that phase of therapeutic exercise devoted to the recovery of effective, voluntary control of skeletal musculature. However, muscle re-education must not be thought of simply as a set of exercises designed to develop strength in muscle. Technics of muscle re-education are designed to develop motor awareness and voluntary response, and/or develop strength, endurance, and patterns of movement that are necessary, effective,

safe, and acceptable. It should be obvious that if the patient is unable to contract voluntarily skeletal musculature, in either direct or associated movements, no degree of muscle re-education can be achieved. Therefore, if the patient is unable voluntarily to contract muscles that are essential to physical activity, the re-education program must begin with the prescription of certain technics designed to activate lower motor unit response.

Many technics are available for both sensory and proprioceptive stimulation when the patient is unable to voluntarily contract skeletal muscle. Rarely is one technic alone adequate in any single instance, and therefore the physician must know all possible technics and use them in whatever combination gives him the best response. Under sensory stimulation, the technics used are concerned with passive motion, stroking or tapping of the muscle and its tendon, electrical stimulation of the muscle, and focusing the use of muscle with the electromyograph.

The use of proprioceptive stimulation and facilitation is now in a stage of renewed interest and use. This is a method of activation, designed to stimulate skeletal muscles to contract through excitation of proprioceptive receptors in the musculoskeletal system. These perceptors of muscular sense can be stimulated by passive motion and by positioning bodily segments in various postural attitudes. Balancing in the sitting, crawling, kneeling and standing positions is a frequently used method of stimulating the proprioceptive system. Any position where a bodily segment attempts to balance itself by the stabilizing tension of muscle will induce proprioceptive stimulation. Methods to facilitate the proprioceptive response have been utilized to initiate muscle contraction. Unfortunately, proprioceptive facilitation has been pictured as a new and somewhat mysterious force that can be utilized only by strict adherence to a particular set of movements.

The movement ritual varies with each method advocated. Actually, Sherrington, over 60 years ago, stressed posture, passive movement, active movement, and resistance to movement as essential to complete proprioceptive response. We have long known that muscle responds best if put under some tension. Sudden stretching of muscle or sudden release of tension will tend to facilitate active response in the muscle. Much is now being written about the use of reflexes, both normal and pathological, in the re-education of voluntary muscle. Reflexes may be utilized to initiate muscle contraction. If the muscle responds through reflex action, this response may be used as a focusing mechanism to assist the patient's voluntary attempts. Actually, the value of passive motion and posture is stimulation of such reflexes. I have not been impressed with the value of pathological reflexes in treatment of neuromuscular dysfunction in that they appear to have no carry-over value of significance.

Exercises. After some degree of voluntary response has been obtained, a system of exercises designed to develop the strength required for necessary activity can then be initiated. Such strength can only be obtained through muscular work. This recovery of strength through work is due at least to three factors:

1. The training effect, due in great part to increased circulation in the development of muscle sense through the proprioceptive system.
2. Hypertrophy of individual muscle fibers.
3. An increased number of motor units entering into the contraction effort.

If spotty and haphazard destruction of motor units has taken place, as in poliomyelitis, some degree of reinnervation will probably occur through a fourth factor: adoption of denervated muscle fibers by adjacent intact neurofibriles. Each of the first three factors, perhaps even the fourth, demands increasing resistance to voluntary effort for maximum response. It makes no great difference how the work load is applied except that it must be neither too little nor too great. If the demands are too little, only a few units will be activated and recovery of strength limited. If the demands are too great, the normal motor unit will respond initially with maximum effort, but then will reject the load and respond only partially. If excessive demands are

repeatedly attempted, muscle weakness may result from overwork. This will be discussed later.

The type of exercise prescribed for muscle weakness will depend on the site and the extent of this muscle weakness. If only a portion of the muscle is weak, then very specific exercises, designed first to build up these strands, and then to incorporate them into larger and more meaningful bodily movements, must be outlined. If the involvement is widespread and diffuse, then gross, over-all exercises can be prescribed, being sure that the balance of strength is constantly checked to determine the need for temporary, specific training of individual groups. The trained physician can easily pick up imbalance of strength by observing changes in patterns of movement.

Overwork and Fatigue

It was emphasized previously that muscular work is essential to recovery of muscle strength. It is now necessary to emphasize that overwork can cause actual loss of strength which may be irreversible. It is not always true that if a little exercise is good more exercise may be better. The normal individual is rarely in danger of overworking.

To better understand this, we must first realize that fatigue and overwork are not synonymous. Fatigue is a perfectly normal physiologic reaction that actually protects us from overwork. Fatigue is a disagreeable sensation, and this plus the normal individual's inherent laziness, adds up to the fact that the average person usually has a muscular system in a state of disuse. Few of us have sufficient discipline to carry out an exercise routine that would be adequate to maintain strength for only occasional demands. Therefore, our strength decreases as we settle into a routine of daily activity. Since strength does not develop immediately upon demand, our limited activity causes limited strength which in turn tends to decrease our activity. Why, then, must we even consider the danger of overwork?

First, it can be stated unequivocally that those of us who have had the opportunity of observing patients who are under a program of progressive muscle re-education, have seen certain of these patients show a deterioration of muscle strength, rather than the expected recovery of strength. Second, we have repeatedly seen specific instances of isolated muscle weakness which could be related directly to weight bearing, or to very specific occupational or recreational demands.

If the fact that loss of strength may result from disuse and changes in the relationship of tendon length to muscle mass is accepted, there is still a third cause which we must accept as overwork. It is a well-known fact that a perfectly normal muscle can be worked to a point where it is unable to contract until a certain period of rest has been given it. This normal, physiologic reaction is certainly due in great part to the accumulation of waste products, which is in turn related to available blood supply and tissue drainage. As mentioned previously, it is also related to the normal disagreeable sensations that arise with fatigue. It would appear that patients with spotty involvement of lower motor units are not so fortunately protected. They are, in the first place, highly motivated, because they realize that recovery of muscle strength is the key to their recovery of functional capacity, and they therefore have the tendency to overwork muscles in the hope that this would bring about more rapid recovery. In addition to this, it may be assumed that their available blood supply is relatively greater than that of the normal, untrained muscle, because their circulation is relatively unchanged even though the numbers of contracting motor units are much less. Therefore, it can be theorized that they may not sense the disagreeable feeling of fatigue occasioned by an overworked circulation which acts to protect the normal individual muscle. Without this disagreeable warning, the periods of overwork extend the periods of rest required for recovery to impractical length, and finally to irreversible loss.

All this means that the physician should not rely on the disagreeable sensations of fatigue to guard his patients against the dangers of overwork. The physician

must depend entirely on his ability to detect very minor changes in the patterns of movement that would indicate loss of strength. Certainly, in dealing with weight-bearing muscles, repeated spot checks of these muscles by routine manual muscle testing will bring out gradual loss of strength. If this is detected early and rest instituted, strength will usually return. If this weakness is not detected early, recovery of strength through rest and graduated exercises may be prolonged or even impossible.

It must be thoroughly appreciated that the physician should not be worried about the temporary loss of muscle power following a bout of exercise. This is normal and may well be followed after rest periods by increased strength. He must, however, be aware that persistent overwork of a muscle may eventually lead to irreversible weakness.

The treatment of loss of strength following a bout of overwork is obvious. The patient must be placed completely at rest, at least to the extent that the muscles failing in strength must not be utilized for several days. These muscles are then gradually exercised against increasing resistance until the strength returns.

Passive Movements and Support. The possibilities of recovery are definitely related to changes in tissue length and bony contour. Excessive shortening or lengthening of muscle, tendon, ligament or fascia, resulting in hypo- or hypermobility of bodily joints, has a profound effect on muscle re-education. These changes in tissue length, particularly when coupled with loss of muscle strength or muscle imbalance, eventually result in distortion of osseous tissue.

Without danger of oversimplification, it may be said that the cause of these musculoskeletal deformities is nothing more or less than persistent faulty positioning of bodily segments. Persistent faulty positioning may occur during rest or during activity, and may be due to various causes, such as pain, weakness, muscle imbalance, or faulty orthetic devices. These deformities are best treated by preventive rather than corrective measures. The physician must anticipate the dangers of persistent faulty position by the early prescription of passive movements and adequate support to maintain mobility and alignment.

As a general statement, it can be said that all musculoskeletal deformities, except the atrophy of denervation, can be prevented or very significantly minimized by proper preventive treatment. Unfortunately, if structural distortion takes place, either in supportive or bony tissue, only surgical correction may be capable of restoring some degree of normal mobility and alignment. Such corrective surgery is certainly a poor substitute for adequate, early, preventive treatment. It must be appreciated, however, that if muscle imbalance due to nerve damage exists, proper balancing of muscle pull may be possible only through tendon transplants, and ultimate stability of bodily segments may be possible only through surgical stabilization.

Orthetic Devices. An orthetic device may be defined as any structure applied to or around a weakened or distorted bodily segment to provide support, assistance in movement, or correction of deformity (in contradistinction to a prosthetic device which replaces a missing part). Leg braces, hand splints, and corsets are commonly used orthetic devices. Special shoes, wheelchairs, and crutches must also be considered orthetic devices.

As stated previously, activity is necessary for the recovery of strength, coordination and endurance. The patient weakened by nerve damage must frequently be supported by adequate orthetic devices to enable such activity to be carried out safely. The greatest change in orthetics over the past 15 years has been the gradual development of what might be termed "functional orthetic devices." Ideally, these devices should be so designed and fitted that they permit and encourage the patient to move about for practical purposes and yet limit any movement that might cause deformity or retard recovery. Such equipment would not only support weakened musculature and other structural tissues, but also permit coordinate movement to increase their strength.

These goals are being recognized by more and more intelligent and experienced orthotists and have resulted in many improvements in design and increased interest in the entire field of orthetics. It is the physician's responsibility to realize that orthetic devices are important and a frequently necessary component of the program designed for recovery, and are not to be considered only as a supportive device indicating failure to recover strength. The physician must also recognize that the very act of imposing restrictions to movement of bodily segments, through the application of orthetic devices, can predispose to dangerous disuse weakness and skeletal deformity, so that the physician must be constantly aware of the dangers as well as the values of such devices.

Within the past few years, orthetic devices capable of markedly increasing functional capacity of completely paralyzed upper extremities have been developed. Unfortunately, many physicians are completely unaware that such apparatus is available. These devices are based on either the so-called "feeder" device or on methods of transmitting power to the shoulder, elbow, and hand through a cable and harness arrangement from adjacent muscles still under voluntary control. More recently a so-called "artificial muscle" is being used to provide essential movements in the upper extremity. Unfortunately, most of this equipment is cumbersome and conspicuous, and at best a poor substitute for normal muscle. However, the devices do permit the completely helpless patient to gain some degree of functional independence.

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If any man can convince me and bring home to me that I do not think or act aright, gladly will I change; for I search after truth, by which man never yet was harmed. But he is harmed who abideth on still in his deception and ignorance.

◇ MARCUS AURELIUS ANTONINUS

discontent is the first step in the progress of a man or a nation.

◇ oscar wilde

Psychiatric Considerations of Hand Disability

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● Consideration of the psychiatric aspects of hand disability must be directed toward an elaboration of the meaning of the hand and its disabilities to the individual, and the various factors involved in determining this meaning. In its general aspects, the biological evolution of the hand and its effect on the function of the individual, the social and anthropological significance of the hand is considered. In its more specific aspects, hand disabilities are discussed from the viewpoint of the special problems which are raised by amputation, prostheses, phantom limb, paralysis, deformity, handedness, congenital versus acquired disability. Finally, the personality of the individual with hand disability is considered, indicating how this factor contributes to the meaning of the disability and the various modes of adaptation to it.

The importance of psychologic factors has long been recognized by those who have had the responsibility of dealing with the hand and its disabilities. Sir Charles Bell,[1] Professor of Surgery in the University of Edinburgh, in 1837 published a magnificent study in which there are numerous references to classical opinions of Galen and others on this subject. More recently, Allen,[2] in a volume on Hand Surgery in World War II, edited by Sterling Bunnell, refers to psychogenic factors in hand injuries, classifies them briefly, and offers suggestions as to their management. What this paper has to offer, then, cannot claim originality, but is designed to complement the other presentations in this symposium, and to draw attention again to the necessity for dealing not alone with the physical disability, but with the patient who has the disability.

Considerations of psychiatric aspects of hand disabilities would seem to fall logically into two categories. The first is a general category, in which the reactions to hand disability are similar to those in any disability. The second is more specific, and is concerned with reactions that are determined by the special importance and meaning of the hand. While this presentation will be concerned primarily with the latter, it may be well to consider the more general aspects of disability as a basis for orientation.

There is a body, a personality, and an external world, animate and inanimate; and to fully understand a person, one must evaluate his functioning in each of these areas as well as the relationship between them. When a person suffers a disability, whether as a result of injury or disease, each of these areas of functioning is affected. It can impair the use of the body as a tool with which to experience and manipulate the environment. Sensation and perception of the external world may be disturbed as a result of blindness, deafness, sensory damage, or brain injury, so that his position in space is disordered. The motor system may be affected so that locomotion and essential movements are impaired. Disability may disrupt the personality dynamics and equilibrium and threaten a way of life. It may cause intense anxiety, depression, and rage. It may be interpreted as punishment for sins real or imagined. It may represent a threat to normal mastery and produce feelings of helplessness and panic. It may unloose previously controlled psychopathology such as paranoid ideas and create intolerable interpersonal relationships. It may be organized into the patient's neurotic strivings, such as dependency or fear of competition, and be unconsciously welcome as a way out of a conflictive struggle. Finally, the disability removes the person from normal social experiences and from work situations — two major sources of satisfaction and self-esteem. Disruption in family life and friendships, separation from loved ones, economic problems, shattered ambitions and dreams — all threaten and damage the socially functioning human being.

The disability, then, represents a massive assault on the individual. How he reacts will depend on a vector resulting from the nature of the disability, the realistic problems it creates, the personality of the individual, his previous his-

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tory and life experiences, the meaning of the disability both conscious and unconscious, and the resources provided by the patient, his family, and society. It is toward an understanding of these factors and their manifestations that psychiatric evaluation in physical disability and rehabilitation sets its goal.

In these respects disability of the hand claims common ground with other types of physical disablements. However, in other respects, the hand is different and special, and because of its unique history and functions, disability of the hand creates unique problems.

Evolutionary Significance of the Hand

"The tradition that man is a fallen angel finds little support in either paleontology or physics. If for his manifest behavior man must be regarded as a fallen creature, it is much more likely that he is an ape fallen from arboreal grace than that he is a fallen angel."[3] The evidence is overwhelming that man, having in the course of evolution ascended the trees, subsequently descended. One theory suggests a change in climate associated with the uplifting of the Himalaya Mountains and the consequent cutting-off of Central Asia from rain-producing and jungle-growing monsoons; the trees disappeared, and our ape was left stranded on the ground. But the linearity of man, his relative hairlessness, his clothing, and his culture-based carnivorousness suggest that the protohumans, like the anthropoids, were warm-climate-adapted animals, caught off base by the Pleistocene Ice Ages, not by Himalayan cataclysms. Many students believe the ancestral ape came down to earth of its own free will, motivated to enlarge its diet, and was able to stay down because of its great strength. It may be that the anthropoids were such successful animals that they grew progressively in size, obedient to "Depérets law," much as the elephant and horse families grew progressively bigger throughout their history. If so, the result of this would be that tree living became more and more inconvenient for locomotion and suitable only for nightly retreat; he simply got too big to float through the air with the greatest of ease.

Taking to the trees, however, had profound effects on the primates. Brachiation, or "arm walking" through the trees, developed much greater maneuverability of the limbs, especially the forelimbs. The human shoulder blade and collarbone are built on the basis of this arboreal primate maneuverability, and the shoulder in man is virtually a universal joint. Getting about in trees — especially in a wingless creature — demands accurately developed position-assessing and distance-gauging eyes, if the brachiation is going to make that next limb safely. There is no doubt that the primate stereoscopic eyes, added to the flexible shoulders and grasping hands, give them a much richer visual-muscular space consciousness than most land animals have.

Though life in the trees increased the biological importance of sight, it also brought about a loss of acuteness in the sense of smell, along with a regression of the snout and the olfactory areas in the brain. This not only accompanied the flattening of the face and helped bring the eyes into one plane for stereoscopic vision, it also made room for the development of a brain in a skull whose total size was limited by pelvic birth. The development of hands also made a snout and powerful jaw unnecessary since food could be caught and placed into the mouth by the hands.

So, early man was an earth-bound ape with empty hands. But it was these same empty hands that changed completely the whole manner of evolution in man and made him unique beyond all comparison with any other living creature. The uniqueness of man's hand is functional, not physical. Of course his primate ancestor's sojourn in the trees did greatly improve the grasping ability of the old amphibian-reptilian-mammalian paw. It is also true that the fully opposable thumb in man is a further improvement on the primate hand. But in purely physical terms, monkey hands could probably do nearly everything a man's hands could. The main significance of the human hand lies in its being one member of a functional complex of hands, brain, and eyes. Man has paired grasping

organs, fully in his field of vision and wholly freed from locomotor duties, in a stereoscopic-sighted big-brained mammal.

The importance of the hand in the development of humans was recognized by the ancient Greeks.[4] Anaxagoras claimed that man had brains because he had hands, but Aristotle argued that man had hands because he had brains. Modern anthropologists and classicists are inclined to give the decision to Anaxagoras, but hands, brains, and eyes are a case of hens and eggs causality. Probably, in primate evolution, they influenced each other mutually and developed progressively together; and the ability to "monkey with things" is still one of the keystones of human nature. Hands, eyes, and brains put an animal into closer object relationship with reality and enlarge the animal ego in the technical sense of increasing awareness and testing reality. Literally, such an animal as man has more contacts with reality.

The importance of the hand and upper extremity is reflected, too, in the extensive cerebral representation governing them, as well as the remarkably rich nexus of nerve supply to the hands compared with other parts of the body. Hughlings Jackson,[5] in his writings on epilepsy, said: "Indeed, the hand is the most important part of the body from any point of view. Hence the significance of the fact that in disease of the highest centres, it usually suffers first and most."

Most remarkable of all is the probability that in this development man has freed himself from the evolutionary process in a physical sense, and all that is really necessary is the evolution of his intelligence. Man's hands make the tools and the machines which render his own physical evolution unnecessary. Machines not only can do man's flying, diving, and superhuman seeing and hearing for him; with human hands, the old style evolution by body adaptation is obsolete. Man's very physical ego is expanded to encompass everything within reach of his manipulating hands, within sight of his searching eyes, and within the scope of his restless brain. Without being, through specialization, a biological amputee, he attaches all sorts of prosthetic devices to his limbs. This evolution by prosthesis is uniquely human.

Just as the hand has played a crucial role in the evolution of man as a human, so it is important in the development of the individual human being. From the time of birth, with the presence of a potent grasp reflex, throughout the various stages of maturation, the hand plays a significant role. It is with the arms and hands that we feed, dress, perform skills, explore our body, and contact persons and things about us. It is with the arms and hands that we love and caress, hurt and kill, disrupt and adapt. Hundreds of activities of daily living, so necessary to mature social functioning, are absolutely dependent on the hand. Interpersonal relationships are expressed often through the hand and the sense of touch, by gestures, handshakes, clenched fists, and so on. Our language with which we communicate contains many words derived from *manus* or hand: manage, manipulate, maneuver, manners, manuscript, etc. The hand is vital in most occupations, whether skilled like the pianist or carpenter, or unskilled like the laborer. Symbolically, the hand has many meanings: sexual, in that it may represent a sexual organ, or guilt derived from using the hand sexually as in masturbation; emotional, as in the expression of anger in the clenched fist. Its role in the development of the individual ego is tremendous, so that it is no surprise that damage or loss of the hand is always accompanied by rather pronounced psychological reactions. In the "Draw-a-Person" psychological test, the most commonly omitted feature is the hands.[6] If they are drawn, they often reveal significant areas of conflict. Many of these reactions are normal or expected, while others reveal significant psychopathology.

Psychiatric Reaction to Hand Disability

There are many factors which determine or influence the psychiatric reaction to hand disability:

1. *Nature of Disability.* The reaction to loss of a hand, as in amputation, may be more severe than to paralysis or deformity of the hand. Association with other disability, as in quadriplegia or

brain damage, will influence the reaction.

2. *Handedness.* Loss of or damage to the dominant hand will precipitate more problems than when the nondominant hand is involved.

3. *Age of Onset.* Congenital deformities or disabilities occurring in childhood will exert a different effect from those occurring in adulthood. The acute sense of loss is not as evident in the very young, nor is the body image schema as well established. However, the effect of the disability on the developing personality may be more profound in the very young.

4. *Previous Personality.* Previous personality will determine the full meaning of the disability, as well as influence motivation in rehabilitation. A person who has strong dependency strivings will tend to use the disability as a rationalization for acting out this need. The patient who has been repressing guilt feelings arising out of sex or aggression may see the disability as a punishment. He may be more accepting of the disability, but for the same reason, may unconsciously resist rehabilitation efforts.

5. *Occupation.* Occupation may be an important determining factor in reaction to disability. A very minor injury to the hand of a pianist or skilled mechanic will pose a more serious threat than to someone not dependent on his hands, such as a writer or actor.

6. *Secondary Gain.* As in compensation cases or in escape from front-line combat in war, secondary gain may determine the psychiatric reaction in predisposed individuals.

These generalities are undoubtedly familiar to all physiatrists, and do not require any special elaboration. There are, however, special problems which are of interest and challenge in hand disability. The first concerns problems associated with amputation of the upper extremity and hand.

Body Image

Amputation of the arm or hand imposes problems related to body image. We all have an image of our body, although most of us are unaware of it. This image is built up over years of multiple perceptions, by postural, tactile, and optic percepts, and over the years the individual modifies and expands this impression of his image. These various sensory impressions are probably organized in the parietotemporal cortex. Apparently this organization is not complete before the age of about six years (phantom limb phenomena are not associated with patients who have sustained a congenital amputation or who have undergone amputation in infancy).[7, 8] It has been suggested that the body image has physiologic significance in that it provides the individual with instantaneous appreciation of his positioning in space. In amputation this source of sensation and kinesthetic function is abruptly removed, and it is not uncommon to hear patients report a sense of imbalance as a result.

It is of interest in this connection that a sensory reorganization takes place in the end of the stump following amputation. In normal limbs, tactile thresholds are smallest in distal regions of the body and highest in proximal parts. Studies of light-touch threshold, two-point discrimination, and point localization reveal that stump sensitivity exceeds that of homologous parts of the sound limbs. Evidence would indicate that this reorganization is a central rather than a peripheral phenomenon.[9]

The body image is more than a percept, but has emotional significance as well, derived from early family conditioning and later cultural values placed on physical development. Thus, in some families in which great physical strength and physical accomplishment are emphasized, a boy's attitude toward his body is determined to a large extent by the parents' feelings and attitude toward development of his limbs and muscles. In a similar manner, the parents may overemphasize physical beauty of girls. Body image, then, becomes associated with values, with good and bad, with attractive and unattractive, with acceptable and unacceptable. Amputation arouses these associations and feelings connected with them.

Phantom Limb

Closely related to the problem of body image and sensory reorganization is the phenomenon of phantom limb. Refer-

ences to the phantom and superstition attached to it can be found in past literature. Ambroise Paré knew of its existence, and Weir Mitchell, with his extensive experience in the Civil War (15,000 amputees), provided one of the best descriptions of it in English literature. According to Bailey and Moersch,[10] phantom limb after amputation is almost universal, reported in as many as 98 per cent of cases. This figure is supported by other series. Ewalt[11] and associates indicate that the painful phantom, in contrast to the painless phantom, is infrequently encountered. In a series of 2,284 amputees seen in an American army hospital during World War II, only 8 patients complained of painful phantom limbs.

Excellent descriptions of the characteristics of phantom illusion exist. After amputation, the phantom is perceived as consisting of the whole extremity. The patient is most aware of the distal portion of the phantom, such as the hand or foot. As time passes, the phantom tends to shrink or telescope.

Henderson and Smyth[12] distinguished three kinds of sensory phenomena of the phantom. There is, in all patients, a mild tingling which forms the basic part of the phantom and which probably arises in the cerebral cortex; second, stronger pins and needles induced momentarily by touching a neuroma in the stump; third, occasional superadded sensations which may be disagreeable and painful and probably have a psychogenic basis. According to Kolb, the painful third order of epiphenomena is the common cause of the amputee's stimulus to consult the physician. Questioning usually reveals that the patient is concerned with sensations which he describes variously as "twisting," "burning," "pulling," or "itching." In most cases his symptom is intermittent. It is more often annoying than agonizing. The more introspective and observant amputee notes its aggravation by changes in the weather, and in many instances by emotionally disturbing experiences.

While many theories have been employed to explain and treat phantom phenomena — biochemical, neurophysiological, and psychiatric — no single one adequately explains nor provides a complete therapeutic regimen for its treatment. There are patients who have undergone, singly and successively, reamputation at higher levels, exploration of the stump, removal of the terminal neuroma, plastic operation on the stump, rhizotomies, sympathectomies, cordotomies, injections of alcohol into the neuroma, paravertebral anesthetic block of the sympathetic ganglia, spinal anesthesia, and resection of the postcentral cerebral cortex, and have remained unrelieved of their painful symptoms. One such patient had undergone 27 surgical and anesthetic procedures in 30 years, the last a resection of the somatosensory cortex, without modification of his painful phantom. However, I would like to discourse briefly on the psychiatric observations that have been made on patients with phantom pain.

Kolb[13] studied 22 such patients in whom physical factors such as neuromas, vascular disease, and spinal cord injury were ruled out. In these patients the complaint of pain appeared to represent an emotional response to the loss of an important part of the body which had significance in terms of the patient's relationships with others. The painful symptom was induced in 9 of the 22 patients by referring to some causes of anxiety in the patient's life. For example, although one patient complained of persistent pain, it was noted that he was without discomfort throughout the diagnostic interview except when certain emotionally charged subjects were discussed. In some patients, exacerbations of pain frequently were precipitated by events in which the patient identified with another person who had suffered a similar traumatic injury. One such patient described by Kolb suffered a first attack of pain in his phantom limb when he initially attempted sexual relations with his wife after amputation. He was concerned then by the fear that his wife would not accept him sexually because of his disfigurement. He was presumably cured by surgical resection of the parietal sensory cortex. The pain recurred with dramatic suddenness six months after the operation when he visited a friend who had just lost his arm in a farm accident.

It is of interest that of 21 patients with painful phantom limb, 14 gave information indicating a close and significant emotional attachment to another amputee in the past.

Depression and Grief

The reaction to loss of a limb, and for that matter the loss of function of a vital part, is grief and depression. Grief or mourning represents intense longing for the missing part, while depression carries with it elements of rage and loss of self esteem. This reaction is similar to that associated with loss of a loved person, and the personalization of the limb is dramatically borne out in the concern of some patients regarding the disposition of the limb. Patients preoperatively express a desire to have the part disposed of as tenderly and respectfully as they would wish for their body, or that of a member of their own family. This has been emphasized by Kolb, one of whose patients suffered from a severe burning pain in the phantom, and who subsequently revealed his anguish over the fact that his limb had been burned rather than buried. Two patients treated by Blood[14] also revealed this concern, which may not be discovered unless there is specific questioning along this line. This attitude toward a vital part of the body is borne out in psychological tests. For example, in a sentence-completion test, one patient responded to the incomplete sentence: "Loss of a limb is ————," with the response: "like the loss of a friend."

Depression arises, also, as a result of loss of mastery derived from the missing or injured part. Studies in surgery of cancer patients by Orbach and Bieber[15] indicate that loss or mutilation of a vital part of the body results in depression where the patient blames himself for the loss of mastery and loss of acceptability, while paranoid reactions occur when the responsibility is projected onto others.

Denial

Depression is related also to another interesting and important psychological defense, that of denial. In denial, the patient either explicitly denies the existence of a disability, insisting his arm is still present or is not disabled or belongs to someone else, or implicitly denies even though the disability is admitted consciously. An example of the former is a patient with a stroke and hemiplegia who, when asked whether he could move his paralyzed arm, replied that the arm was not his but belonged to the patient who had previously occupied his bed. An example of the latter is a woman who suffered an amputation for bone sarcoma, and was reasonably well adjusted until the first fitting of her prosthesis, following which she became despondent and suicidal. What had disturbed her most was the realization that she felt no sensation in the prosthetic arm. While consciously aware of her amputation, her deepest wish and fantasy was for complete restoration, which may have played a part in her phantom limb and pain.

Denial of disability has been studied recently.[16-18] While much of the literature has been concerned with disability associated with brain injury, and while it is more common and usually more explicit in the brain-damaged, it also occurs in the non-brain-injured, as in simple amputations. It is an important defense of the ego which, if disrupted, leads to feelings of helplessness, vulnerability, and inadequacy — all characteristic of depression. Often the depression is masked by somatic preoccupation and by anxiety with its somatic components and agitation.

Prostheses

Discussion of amputation leads us logically into a consideration of problems associated with prostheses. Physically, prostheses are concerned with function and with cosmetic effect. Psychologically, fitting a patient with a prosthesis confronts the individual with an irrevocable reality, and thus it may stir up basic psychiatric problems. In fact, the attitude of the patient toward the prosthesis is determined by the sum total of his psychological response to his disability. Wittkower[19] has suggested that the attitudes of amputees toward prostheses are chiefly of five types:

1. A means of concealing disability.

2. A working instrument or tool.
3. A means of restoring completeness of body image.
4. A substitute for loss of a precious belonging.
5. A recompense for sacrifice in service to one's country.

It should be apparent that to properly fit a prosthesis, one must understand quite thoroughly the attitudes of the patient toward his disability. Mechanisms of denial, such as the previously mentioned patient who expected sensation in her limb, should be determined and anticipated.

The patient's choice between function and cosmetic effect is an interesting one. Some patients will choose the hook for prehension, some will choose the cosmetic, plastic hand for appearance, while a few demand both, one to be used for work, the other in social situations. Rorschach studies on amputees with prostheses indicate not only the psychological factors in the choice of prosthesis, but also in the efficiency or inefficiency with which they are used. In general, those patients who exhibited self-control over emotions tended to choose the functional hand and were more efficient, while those who had less control over emotions tended to choose cosmetic hands and were more inefficient.

Related to the attitude of the amputee toward his prosthesis is the attitude of normal individuals and of society toward the artificial hand. The characterization in literature of Long John Silver, Captain Ahab, and Captain Hook, are indicative that amputees do arouse morbid and threatening fantasies of personal mutilation in normal people. An attempt to study normal reactions to the APRL cosmetic glove produced some interesting results.[20] Of 30 persons exposed to an amputee wearing an artificial hand covered with the APRL cosmetic glove, only 6 (20 per cent) recognized the prosthesis as in any way different from the real hand. In these 6 cases, the artificial hand was seen as different, as injured, only when the wearer tried to perform some task with it. Even then, it was still seen as a hand, the wearer's own hand and not as a prosthesis.

Paralysis and Deformity

While much of this presentation has been concerned with amputations and their consequences, what has been said applies as well to disabilities such as paralysis and deformity of the hand.

The patient with paralysis does not suffer the loss of the anatomical part as does the amputee, but he does suffer the loss of function. Where the paralysis is a flaccid one, the arm is seen as dead, and the patient will repeatedly lift the hand with his good one, then let it drop, hoping that signs of life will return. Projective psychological tests reveal the subjective thoughts and feelings regarding the paralysis. Images of death, as the withering of a plant or the drying up of the body, are encountered frequently. Depression is always present, and where the paralysis is associated with brain damage, as in cerebral-vascular accident, phenomena of denial are more likely to appear. These are striking and dramatic, ranging from complete denial of illness, as in anosognosia, to partial denial, as in unrealistic appraisal of the loss of function. One may see reduplication, as in the patient who states he has three arms, one paralyzed and two normal. There may be projection, as in the patient who denies his own paralysis but states the nurse's arm or his brother's arm is paralyzed.

If the paralysis is spastic, apart from the problems of pain and contracture, a prominent problem will be an aesthetic or cosmetic one. Concern for attractiveness is deeply rooted, and can be seen in the preening of animals, the extensive rituals of primitive peoples, and the emphasis on beauty and appearance in every civilized society. The hand has been a standard of beauty, character, and expression, and distinctions are made between sensitive hands, coarse hands, strong hands, and feminine and masculine hands. Artists have always been fascinated by hands—Blake and da Vinci, Michelangelo, and Rodin.

The fact that the hand is an exposed part of the body is a factor in this concern with aesthetics. Like the face, it is exposed to the view of others. The cosmetic importance of the hand is well

recognized by the surgeons, who deal with it much as they do the face. Incisions follow normal creases, sutures are very fine, and scars must be as delicate as on the face.

The symbolic significance of the hand becomes quite prominent when there is deformity. The clawhand is a symbol of aggression, looked on with fear, as if something evil. The sexual significance of the hand, associated with guilt regarding masturbation, as well as being projections of the body like a penis or breast, is usually not evident except in severely disturbed patients, often schizophrenic. I can recall my first assignment in clinical psychiatry as a third-year medical student, a young girl with an amputated arm, a schizophrenic, who spent hours each day washing the stump, rubbing it, fondling it. It took no psychoanalytic sophistication to recognize what this meant to her. Another patient, also schizophrenic, was unable to touch his wife with his spastic, deformed hand because it represented a defective penis to him. Kolb mentions the castration meaning of amputation in his monograph, but there, too, the examples given are schizophrenic patients. It should be emphasized that in normal or neurotic patients — the vast majority — one does not obtain such phenomena, although it may be deeply rooted in outside awareness.

Summary

This presentation does not presume to have completely covered the subject of psychiatric aspects of hand disability. Rather, a few selected topics were chosen for exploration: evolutionary significance of the hand, amputation, phantom limb and pain, problems of prostheses, depression, denial, and briefly, paralysis and deformity. While medicine has tended toward increasing specialization, it has also seen the need for integration. While surgery has developed specialties in orthopedics, plastic surgery, and neurosurgery, the recognition of the peculiar properties of the hand has led to the integration of these three specialties into the one of hand surgery. Physical medicine, formerly concerned with the use of physical modalities in therapy, has developed into the more integrated specialty of physiatry, incorporating the complex philosophy and technics of rehabilitation. Psychiatry, formerly on the periphery of medicine, has moved inward to take its rightful place with other medical specialties. We must be concerned not alone with the disability, but with the person who has the disability as well.

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References

1. Bell, Sir C.: The Hand, Its Mechanism and Vital Endowments, As Evincing Design, London, William Pickering, 1837.
2. Allen, S.: Survey of Hand Injuries in Mediterranean Theater of Operations, in Hand Surgery in World War II, chap. 3, edited by S. Bunnell, Office of Surgeon General, Department of the Army, Washington, D. C., 1955.
3. La Barre W.: The Human Animal, Chicago, University of Chicago Press, 1954.
4. Farrington, B.: Head and Hand in Ancient Greece, London, C. A. Watts & Co., Ltd., 1947.
5. Jackson, J. H.: Selected Writings, New York, Basic Books, Inc., 1958, vol. 1, p. 68.
6. Machover, K.: Personality Projection in Drawing of Human Figure, Publications 25, American Lecture Series, monograph in American Lectures in Psychology, Springfield, Ill., Charles C Thomas, Publisher, 1949.
7. Drever, J.: Early Learning and Perception of Space. Am. J. Psychol. **68**:605, 1955.
8. Survey of Child Amputees at Mary Free Bed Hospital, Grand Rapids, Mich., New York University College of Engineering, 1957.
9. Haber, W. B.: Effects of Loss of Limb on Sensory Functions. J. Psychol. **40**:115, 1956.
10. Bailey, A. A., and Moersch, F. P.: Phantom Limb. Canad. M.A.J. **45**:37 (July) 1941.
11. Ewalt, J. R.; Randall, G. C., and Morris, H. D.: The Phantom Limb. Psychosom. Med. **9**:118 (Mar.-April) 1947.
12. Henderson, W. R., and Smyth, G. E.: Phantom Limbs. J. Neurol., Neurosurg. & Psychiat. **11**:88 (May) 1948.
13. Kolb, L. C.: The Painful Phantom, Publications 235, American Lecture Series, monograph in American Lectures in Neurology, Springfield, Ill., Charles C Thomas, Publisher, 1954.

14. Blood, A. M.: Psychotherapy of Phantom Limb Pain in 2 Patients. Psychiat. Quart. **30**:114 (Jan.) 1956.
15. Orbach, C. E., and Bieber, I.: Depressive and Paranoid Reactions. A.M.A. Arch. Neurol. & Psychiat. **78**:301 (Sept.) 1957.
16. Rosen, V. H.: Role of Denial in Acute Postoperative Affective Reactions Following Removal of Body Parts. Psychosom. Med. **12**:356 (Nov.-Dec.) 1950.
17. Weinstein, E. A., and Kahn, R. L.: Denial of Illness: Symbolic and Physiological Aspects, Publications 249, American Lecture Series, monograph in Bannerstone division of American Lectures in Neurology, Springfield, Ill., Charles C Thomas, Publisher, 1955.
18. Fisher, S. H.: Mechanism of Denial in Physical Disabilities. A.M.A. Arch. Neurol. & Psychiat. **80**:782 (Dec.) 1958.
19. Wittkower, E.: Rehabilitation of Limbless: Joint Surgical and Psychological Study. Occup. Med. **3**:20, 1947.
20. Cattell, E., and others: Social Usefulness of Cosmetic Glove, New York University College of Engineering, Research Division, 1949.

Information relative to securing reprints of this study may be had by checking the Reader Service column on page iv of this issue.

Because I have confidence in the power of truth and of the spirit, I believe in the future of mankind. Ethical world-and-life affirmation contains within itself an optimistic willing and hoping which can never be lost. It is, therefore, never afraid to face the dismal reality, and to see it as it really is.

The only possible way out of the present chaos is for us to adopt a world-view which will bring us once more under the control of the ideals of true civilization which are contained in it.

One belief of my childhood I have preserved with the certainty that I can never lose it: belief in truth. I am confident that the spirit generated by truth is stronger than the force of circumstances.

◇ ALBERT SCHWEITZER

Perception in Hemiplegia: II. Judgment of the Median Plane

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● A group of hemiplegic patients and control patients were examined in a task which involved the perception of the median plane under **dark** and **light** conditions. Under dark conditions, the total hemiplegic group showed significantly larger median plane alterations than did the control group. Both the right hemiplegic and left hemiplegic groups perceived the median plane to be significantly displaced to the affected side of the body. Under light conditions, median plane alterations were markedly reduced, but the hemiplegic group still showed significantly greater errors than did the control group. The results are discussed in connection with the alteration in the mechanisms of median plane perception in hemiplegia.

The rehabilitation of the hemiplegic patient is primarily concerned with the reorganization of his residual motor functions. Since this process of motor retraining is dependent in part upon the adequacy of perceptual systems,[1-4] increasing concern has been exhibited in the character of the patient's sensory and perceptual functioning.[5-9]

Among the many features of perception,[10] the organization of visual perception occupies a central place in the adaptive activity of the adult human being. In a previous investigation,[5] we have shown that hemiplegia is frequently accompanied by disturbances in the visual perception of the vertical and horizontal. The present investigation is concerned with the manner in which an individual perceives the relation between environmental objects and himself. This aspect of visual perception involves the ability of the individual to recognize grossly that an object is before him or behind, and more subtly whether it is straight ahead, to the right of his midline or to the left of it. Accuracy of action requires that the subjective visual perception of straight ahead coincides with the objective median plane. Consequently, a discrepancy may contribute to difficulties in motor functioning.

Method

Judgment of the median plane was studied both in the dark and under conditions of normal illumination. Subjects were asked to report when a rod which was moved through the horizontal plane appeared "just in front of the middle of your body."

The patient was seated either in the dark or in normal illumination, a distance of 3 meters from a luminous rod. The experimenter made sure that the patient understood what was meant by "middle of your body." Instructions were then given as follows: "I am going to move this rod back and forth. Tell me which way I should move it to make it come to your middle. When it reaches the middle tell me to 'stop'."

The rod was moved across a table so that on 10 trials the starting position was at least 30 cm. to the right of the patient's midline and on 10 trials from a position which was at least 30 cm. to the left of the patient's midline. For each condition 20 trials were given in *abba* order. Testing was alternated, so that half of the subjects began with light while the other half began with dark.

Subjects

A total of 40 patients were examined under both dark and light conditions. Groups consisted of 14 right hemiplegics, 11 left hemiplegics, and 15 control subjects. The control patients were 12 individuals with musculoskeletal disabilities, but with no known central nervous system damage, and 3 normal members of the hospital staff. The salient characteristics of the subjects tested are presented in table 1.

Visual field examinations were given to 11 patients in the right hemiplegic group and 7 patients in the left hemi-

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plegic group. One of the left hemiplegic group indicated a marked field constriction, with the remaining patients having essentially normal visual fields. Inspection of the relationship of the visual field data to median plane perception revealed no dependable relationship.

Results

Judgment of the Median Plane in Dark. The values in table 2 summarize the judgments of the median plane in the dark.

The Magnitude of Error: The average errors in table 2 indicate that the hemiplegic patients as a group judged the median plane less accurately than did the control group. When responses of both right and left hemiplegics were combined, the total group had a mean average error of 41.5 cm. Examination of table 3 indicates that the mean average error of the total hemiplegic group differed significantly from that of the control group ($p<.02$). The left hemiplegics also differed significantly in their mean average errors from the control subjects ($p<.01$). However, the right hemiplegics, while inferior in their performance to the controls, only approach a significant difference in judgments ($p<.07$). The average errors of the hemiplegic groups were not significantly different from each other.

The Size and Direction of Error: Relevant data are graphically expressed as angular deviations in figure 1. It may be seen that left hemiplegics and control subjects both exhibited a tendency to perceive the subjective midline at some distance to the left of the objective median plane. The direction of errors made by the right hemiplegics was significantly different from that of the controls ($p<.05$) and from that made by the left hemiplegics ($p<.01$). Since the right and left hemiplegic groups have opposite directional error tendencies, it is not surprising to find that, when the data for these two groups were combined, no significant directional difference from the controls was found.

Table 1: Characteristics of Patient Population Used in the Perception of Median Plane

Group	N	Mean Age	Mean Duration of Illness	Mean IQ
Right Hemiplegia	14	62 yrs.	3 yrs.	82
Left Hemiplegia	11	67 yrs.	4 yrs.	95
Control	15	59 yrs.		89

Table 2: Size, Direction and Variability of Subjective Judgments of Median Plane (Dark)

Group	N	Constant Error*	Average Error	Mean Standard Deviation
Control	15	−9.39± 1.34	22.99±23.46	15.71± 1.89
RH	14	14.47±33.60	36.10±16.10	17.71±10.70
LH	11	−33.28±31.10	45.45±13.38	14.75±10.97
Total Hemi.	25	−9.40±36.69	41.50±12.82	16.23±11.10

*+ indicates deviation to right of patient's midline.
− indicates deviation to left of patient's midline.

Table 3: Significance of Differences Between Group Judgments of Median Plane (Dark)

Groups	Constant Error	Average Error
Total Hemi./C	p —	p <.02
RH/C	p <.05	p <.07
LH/C	p <.01	p <.01
RH/LH	p <.01	p —

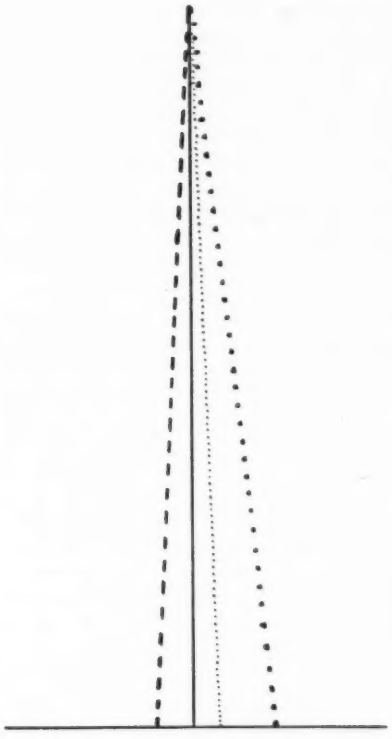

Fig. 1 — Mean directional tendencies in dark expressed as angular deviations from median plane. (.... Control Group; - - - - Right Hemiplegic Group; • • • • Left Hemiplegic Group).

When the direction of error independent of its magnitude was analyzed, it was found that 91 per cent of the left hemiplegic patients made left errors, and 72 per cent of the right hemiplegic patients made right errors. These tendencies, when subjected to chi square analysis, revealed that the left hemiplegic trend was significant at the .01 level, whereas, the right hemiplegic tendency was not statistically significant at the .05 level. The control subjects tended to make left errors (80 per cent), a directional tendency which is significant at the .02 level of confidence.

The Variability of Judgment: Examination of the standard deviations of judgments presented in table 2 indicates that the variability of performance of the hemiplegic groups was not significantly greater than that of the control subjects (*cf.* table 2).

Judgment of the Median Plane in Normal Illumination. Magnitude of Error: The judgments of the median plane that were made by the subjects under conditions of normal illumination are summarized in tables 4 and 5. In analyzing the magnitude of errors, independent of their direction (the average errors), it may be seen that the hemiplegic groups made larger errors than did the control group. However, the difference is in-

Table 4: Size, Direction and Variability of Subjective Judgments of Median Plane (Light)

Group	N	Constant Error*	Average Error	Mean Standard Deviation
Control	15	1.15±2.26	2.42±1.47	1.13± .84
RH	13	3.25±2.54	3.85±2.14	1.79±1.41
LH	11	2.10±1.64	3.23±1.66	2.54±1.74
Total Hemi	24	2.67±2.33	3.54±2.00	1.46±2.10

* indicates deviation to right of patient's midline

Table 5: Significance of Differences Between Group Judgments of Median Plane (Light)

Groups	Constant Error	Mean Standard Deviation
Total Hemi./C	$p < .05$	p —
RH/C	$p < .05$	p —
LH/C	p —	$p < .03$
RH/LH	p —	p —

sufficiently large to reach the conventional lower limit of statistical significance ($p<.07$, *cf.* table 5).

Size and Direction of Error: When the directional character of the judgmental errors is examined by use of the constant errors, it is found that all three subgroups tended to judge the subjective midline to be to the right of the objective median plane. It should be noted that this represents a reversal of directional error tendency for the left hemiplegics and for the control subjects as compared with their performances under dark conditions. The right hemiplegics still exhibited a right directional tendency under conditions of normal illumination. However, the magnitude of this tendency is considerably diminished.

Analysis of the performance of the subgroups in relation to one another reveals that no significant differences exist between the mean directional errors of the right and left hemiplegic groups. However, the mean directional errors of both the right hemiplegic group and the total hemiplegic group were significantly different from that of the control subjects ($p<.05$, *cf.* table 5).

If direction of error independent of magnitude is analyzed, it is found that 85 per cent of the right hemiplegics, 91 per cent of the left hemiplegics, and 73 per cent of the controls showed right error tendencies. Obtained values of chi square indicate that the directional tendencies for the right and left hemiplegic groups were significantly different from chance expectancy ($p<.05$ and $<.01$). The control group directional tendency was not significantly different from chance expectancy.

The Variability of Judgment: When variability (standard deviation) in judgment is considered (*cf.* table 4), it is found that only the left hemiplegic group was significantly more variable in its judgments than the control group ($p<.03$). None of the other comparisons was productive of significant differences.

Discussion

Systematic alterations in the perception of the median plane attend hemiplegia. These alterations are not the result of general reduction in function reflected in differences in IQ level, since the performance of the left hemiplegic group with a significantly higher Mean IQ was no better than that of the right hemiplegic patients. An understanding of these alterations may be approached through an analysis of the factors that are operative in normal median plane perception.

In any individual, the ability to determine which features of the environment are directly related to his bodily midline depends upon the following: (1) the head and body midlines coincide, (2) visual phenomena such as convergence and equivalence of retinal image are normally adequate, and (3) the head and body are appropriately aligned to either the vertical or horizontal parameters of the gravitational field. Disturbance of a systematic kind, therefore, may stem from altered visual dominance, from changed head-body positional relationships, or from altered relations to the horizontal and the vertical. Since no uncorrected visual difficulties exist in our subjects, it is unlikely that visual factors, as such, are making the determinative contribution for systematic midline deviation. It is more likely that the systematic directional tendency is the product of altered head-midline-body relations. Such head-body discrepancies can stem from altered sternocleidomastoideus contraction balance, or from alterations in neck muscle tonus that yields nonequivalent bilateral sensory input. The role of such mechanisms in visual perception should be explored. Until such a study occurs, it is important to be aware of the possible consequence of such peripheral musculoskeletal alterations on visual orientation in space.

Regardless of the specific mechanisms that are eventually implicated as causal in producing median plane deviation, the mere fact of such alteration in visual function has certain practical implications for rehabilitation. The contrast in test performance during normal illumination and in the dark may have an obvious implication for the management of the hemiplegic patient already indicated by Bruell, Peszczynski, and

Albee.[7] Nocturnal deterioration should be anticipated as well as anxiety which, if unresolved, may manifest itself as disturbed behavior.

It has commonly been observed that the hemiplegic patient in ambulation training often finds it difficult to move in a straight line between points, and that the angular deviation is toward the side of the affected limb. Usually, such deviance in locomotion is viewed as the consequence of muscular weakness on the affected side. However, it may well be that the locomotor angulation is at least partially the product of a systematic distortion in median plane perception, and that the body, in a sense, is following the angle described as midline by the visual field. If this is the case, ambulation training, as well as training for adequate object apprehension, may require special education of the visual system as well as strengthening of muscular structures. It should also be noted that deviation of the visual median plane may also exert effects upon the ability to localize auditory stimuli, and that the visual deviation may be accompanied by features of auditory displacement.[11]

A final feature of the data that requires some consideration is the tendency on the part of all subjects to approximate more closely the objective median plane under conditions of normal illumination. Qualitative observations suggest that such an improvement in function is based first upon the visual orientation of head midline to body midline and, second, upon the utilization of cues as to the midpoint of the apparatus. The responses in normal illumination tended often to be based upon the judgment of equal division intervals in the apparatus and not upon midline-object relationships. Consequently, it is apparent that under conditions of normal illumination in nonstressful situations median plane distortion may be partially corrected through the compensatory use of visual object relations.

Summary

A group of hemiplegic patients and control patients were examined in a task which involved the perception of the median plane under dark and light conditions. Under dark conditions, the total hemiplegic group showed significantly larger median plane alterations than did the control group. Both the right hemiplegic and left hemiplegic groups perceived the median plane to be significantly displaced to the affected side of the body. Under light conditions, median plane alterations were markedly reduced, but the hemiplegic group still showed significantly greater errors than did the control group. The results are discussed in connection with the alteration in the mechanisms of median plane perception in hemiplegia.

References

1. Birch, H. G., and Bitterman, M. E.: Reinforcement and Learning: Process of Sensory Integration. Psychol. Rev. **56**:292, 1949.
2. Birch, H. G., and Bitterman, M. E.: Sensory Integration and Cognitive Theory. Psychol. Rev. **58**:355, 1951.
3. Hebb, D. O.: Organization of Behavior: A Neuropsychological Theory, New York, John Wiley & Sons, Inc., 1949.
4. Lashley, K. S.: Persistent Problems in Evolution of Mind. Quart. Rev. Biol. **24**:28, 1949.
5. Birch, H. G.; Proctor, F.; Bortner, M., and Lowenthal, M.: Perception in Hemiplegia: I. Judgment of Vertical and Horizontal by Hemiplegic Patients. Arch. Phys. Med., to be published.
6. Bruell, J. H., and Peszczynski, M.: Space Perception in Hemiplegic Patients as Related to Rehabilitation, Mimeographed abstract, 1956.
7. Bruell, J. H.; Peszczynski, M., and Albee, G. W.: Disturbance of Perception of Verticality in Patients with Hemiplegia: Preliminary Report. Arch. Phys. Med. **37**:677 (Nov.) 1956.
8. Bruell, J. H.; Peszczynski, M., and Volk, D.: Disturbance of Perception of Verticality in Patients with Hemiplegia: Second Report. Arch. Phys. Med. **38**:776 (Dec.) 1957.
9. Van Buskirk, C., and Webster, D.: Prognostic Value of Sensory Defect in Rehabilitation of Hemiplegics. Neurology **5**:407 (June) 1955.
10. London, I. D.: Research on Sensory Interaction in the Soviet Union. Psychol. Bull. **51**:531, 1954.
11. Wallach, H.: Role of Head Movements and Vestibular and Visual Cues in Sound Localization. J. Exper. Psychol. **27**:339, 1940.

Information relative to securing reprints of this study may be had by checking the Reader Service column on page iv of this issue.

survey of selected literature

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AMERICAN JOURNAL OF PHYSICAL MEDICINE. *Vol. 38, Oct. 1959.*

◇ **A Study of IQ Retest Evaluations on 370 Cerebral Palsied Children. L. B. Hohman, and D. R. Freedheim. pp. 180-187.**

Because of the lack of conclusive evidence in the literature concerning the effect of maturation and growth on the intellectual development of cerebral palsied individuals the authors present the retest IQ evaluations on 370 persons with cerebral palsy.

The patients had been medically examined and intellectually tested at the North Carolina Cerebral Palsy Hospital, Durham, N. C. The children were tested with the Stanford-Binet, the Vineland Social Maturity Scale, the Cattell Infant Scale or the Wechsler Intelligence Scale for Children, the choice of the test being dependent on the age and nature of the handicap.

Of the 370 persons, 122 were retested between 6 and 12 months following the initial testing. The remaining 248 persons were retested after an interval of at least one year.

In the series of persons retested more than one year after the initial testing, 46.8 per cent gained or lost five or less IQ points and approximately 25 per cent shifted 11 or more IQ points. Of the 122 persons retested within a year of the initial evaluation, 60 shifted more than 11 IQ points.

In the non-handicapped population a shift of plus or minus five IQ points is within the limits of error of the test. Because of neuromuscular, sensory, and other handicaps, the authors believe that the statistical limits for error in a cerebral palsied population is closer to 10 IQ points up or down.

It is concluded that the present methods of testing persons with cerebral palsy are adequate since the IQ's of approximately 75 per cent of the persons in this study shifted within plus or minus 10 IQ points.

◇ **Biochemical Changes in Muscle Consequent Upon Interruption of the Motor Nerves. G. Schapira, and J. Dreyfus. pp. 207-215.**

The authors present a brief but extensive review of the literature on the biochemical phenomena which occur in the denervated muscle.

There are varied opinions among investigators as to the mechanisms of the biochemical changes during muscular atrophy. The majority of investigations have been concerned with the late effects. The authors make a plea for more accurate recognition of the phenomena occurring immediately following nerve section.

Numerous difficulties arise in the interpretation of biochemical phenomena. Disturbances in posture and in muscular action resulting from denervation in the experimental animal give rise to trophic disturbances (which are unrelated to the biochemical phenomena of the section). Simultaneous section of sympathetic fibers gives rise to focal vasodilatation with permanently increased blood flow. Histological interpretation problems arise if absolute quantities of the various muscle constituents are not expressed as percentages of the total weight of the muscle. Difficulties in chemical interpretation arise when an enzyme extracted for assay is vital for the orderly progression of a chemical reaction thereby producing a situation unfavorable for assay of the next enzyme.

Finally, when conclusions are drawn for data accumulated, two points of view can be taken. On the one hand, changes may be related to the trophic influence of nerve on muscle resulting in a disorder of cellular permeability thereby altering the components of the internal nuclei and initiating disturbances of biosynthesis and renewal of the various muscle constituents. On the other hand, changes in muscular tension from denervation may effect the metabolism in the muscle. Neither of these views has been proved.

Role of acetocholine in axonal conduction and neuromuscular transmission. *Nachmansohn, David. p. 190.*

JOURNAL OF APPLIED PHYSIOLOGY. *Vol. 14, Sept. 1959.*

◇ **Aortic Blood Flow in Dogs During Treadmill Exercise. D. L. Franklin; R. M. Ellis, and R. F. Rushmer. pp. 809-812.**

Continuously recorded aortic flow registered simultaneously with other parameters of cardiovascular work was obtained during spontaneous activity by six dogs.

Aortic flow was measured by a pulsed ultrasonic flow meter. The velocity of aortic blood was determined by calculating the difference between the transit times of ultrasonic waves directed upstream and downstream. To record flow velocity, the difference in transit time of the ultrasonic waves is converted into a D.C. voltage, which can be calibrated in terms of volume flow and inscribed on an oscillograph. The accumulated flow over a time interval of two seconds was determined by an integrating circuit which measured the areas under all flow deflections for the given period of time. Left ventricular diameter was registered continuously in terms of the transit time of ultrasonic waves between two barium titanate crystals mounted on opposite sides of the chamber.

In three dogs the flow meter was applied to the wall of the descending thoracic aorta and in three others, the gauges were applied to the ascending aorta just above the aortic valves. The dogs were subjected to treadmill exercise at three miles per hour on a five per cent grade.

The results of this study showed the heart rate increased by two or threefold while the aortic flow per stroke was only slightly increased. The authors concluded that during standard exercise the flow of blood through the aorta was increased primarily by tachycardia with very little increase in stroke output.

◇ **Capillary Resistance and Blood Pressure Changes Associated with Pain Due to Local Cooling: Cold Pressor Test. G. A. McMurray, and L. B. Jaques. pp. 813-816.**

Measurements of capillary resistance and blood pressure were made on 48 male and female volunteers before and after immersion of the right hand in ice water for five minutes. Fourteen of the subjects were tested in the summer months (July and August) while the remainder were tested in the winter (November to March).

Capillary resistance was measured by an electric suction pump which maintained a vacuum reservoir at a negative pressure measured by a mercury manometer. The negative pressure necessary to produce one or more petechiae in 60 seconds was recorded as the capillary resistance.

The capillary resistance rose sharply immediately after stress and remained elevated for over three hours, returning to normal in 21 hours, while the blood pressure response reached its peak in 90 seconds. A significant negative correlation was found between the maximum changes in capillary resistance and blood pressure.

Other investigators have concluded that the efferent mechanism of the cold pressor reaction consists of a rapid neural component followed by a later and longer lasting humoral action. Epinephrine is suspected of being the humoral agent since its injection into humans produces a capillary stress response very similar to the one observed in this study.

Effect of mechanical factors on respiratory work ventilatory responses to CO_2. *Eldrige, F., and J. M. Davis. p. 721.*

Upper airway obstruction in the unconscious patient. *Safar, P.; L. A. Escarraga, and F. Chang. p. 760.*

Oxygen consumption and body temperature during sleep in cold environments. *Kreider, M. B., and P. F. Iampietro. p. 765.*

Effects of artificially induced fever on serum proteins, vitamin levels, and hematological values in human subjects. *Mendez, J.; N. S. Scrimshaw; C. Salvado, and M. L. Selva. p. 768.*

Methods of cooling subjects with hyperpyrexia. *Wyndham, C. H.; N. B. Strydom; H. M. Cooke; J. S. Maritz; J. F. Morrison; P. W. Flemming, and J. S. Ward. p. 771.*

Changes in osmotic pressure and ionic concentrations of plasma during muscular work and recovery. *DeLanne, R.; J. R. Barnes, and L. Brouha. p. 804.*

Energy metabolism and gas exchange during treadmill running in dogs. *Young, D. R.; R. Mosher; P. Erve, and H. Spector. p. 834.*

Influence on ureteral obstruction (hydronephrosis) on renal function in man. *Edvall, C. A. p. 855.*

A pedal push-pull device for supine exercise. *Fishman, A. P., and G. M. Turino. p. 864.*

Impedance matching circuits for the mercury strain gauge. *Elsner, R. W.; C. J. Eagan, and S. Andersen. p. 871.*

JOURNAL OF BONE AND JOINT SURGERY. *Vol. 41A, Oct. 1959.*

◇ **Stress Fractures of the Calcaneus. J. W. Leabhart. pp. 1285-1290.**

Stress fractures of the calcaneus were seen in 134 United States Marine Corps recruits at Parris Island, S. C., for an incidence of 0.45 per cent of the total number of new recruits. Bilateral calcaneal fractures occurred in 98 patients. The recruits with fractures were slightly older and were less active physically prior to enlistment. The height and weight of the recruits with fractures did not differ from the others.

All patients complained of painful swelling of the heel (or heels) which occurred during the first ten days of training. Edema in the area of the precalcaneal bursa and tenderness over the posterosuperior calcaneus were present in every patient.

Roentgenograms were negative at the time of the first examination, three to five days after onset of symptoms. Ten days after the onset of symptoms a definite line could be seen in the posterosuperior portion of the calcaneus perpendicular to the trabecular stress lines.

Treatment consisted of bed rest for one week, then four point crutch walking was instituted with one-half inch sponge rubber heel inserts in both shoes. Crutch walking was discontinued when symptoms disappeared and most patients were able to return to duty in eight weeks.

The most common theory as to the cause of stress fractures is bone exhaustion from rhythmically recurring subthreshold traumata. The author estimates, from outpatient records, that calcaneal fractures represent 19 per cent of all stress fractures.

◇ **Paraplegia in Children. P. L. Norton, and J. J. Foley. pp. 1291-1309.**

This paper is a review of 65 children with paraplegia followed for as long as 10 years. Forty-eight of the patients were congenital paraplegics and 17 were acquired. The authors were primarily concerned with the orthopedic problems which developed and the functional status of the patients.

All of the group with congenital paraplegia had a diagnosis of spina bifida. Of the 48 patients, 44 had defects including the entire sacrum with approximately one-half of the group having their lesion extending through the third lumbar vertebra.

Orthopedic defects requiring surgical correction were considerably more common in these children than in adult paraplegics, especially so in the congenital group. Three of the patients in the congenital group required spinal fusion. There were 27 dislocations and 19 subluxations of the hip, 14 of which required hip stabilizing operations. Release of hip flexion contractures was the most common operation with 20 procedures of this type performed.

The authors stressed the dangers of passive stretching of the knees in paraplegic children. The hazards include epiphyseal damage, fractures about the knee, and subluxations of the knee.

In the acquired paraplegia group there was considerably less surgery performed, probably because of the relative maturity of the skeleton before the onset of the paraplegia. Ten of these patients were 14 years or older at the time paralysis occurred.

In regard to ambulation, only nine of 48 congenital paraplegics were not ambulatory while in the acquired group six of 16 were not able to ambulate.

Factors preventing downward dislocation of the adducted shoulder joint. An electromyographic and morphological study. *Dasmajian, J. V., and F. J. Bazant. p. 1182.*

The effect produced in the cartilaginous epiphyseal plate of the immature dogs by experimental surgical traumata. *Campbell, C. J.; A. Grisolia, and G. Zanconato. p. 1221.*

The role of soft tissues in osteogenesis. An experimental study of canine spine fusions. *Hurley, L. A.; F. E. Stinchfield, and A. L. Bassett. p. 1243.*

Amputation as a treatment for certain lower extremity congenital abnormalities. *Aitken, G. T. p. 1267.*

Fundamental aspects of muscle function. *Mommaerts, W. F. H. M. p. 1315.*

NEUROLOGY. *Vol. 9, Nov. 1959.*

◇ **Refractory and Irresponsive Periods of Muscle in Progressive Muscular Dystrophy and Paresis Due to Lower Motor Neuron Involvement. Thomas W. Farmer; Fritz Buchthal, and Paul Rosenfalck. pp. 747-756.**

The absolute refractory period and the irresponsive period were measured in the muscles of normal subjects and patients with progressive muscular dystrophy, peripheral nerve injury, and amyotrophic lateral sclerosis. Paired bipolar needle electrodes, 15 to 25 mm apart were inserted into the distal part of the tested muscle. The muscles were stimulated by the two needles in succession. The absolute refractory period was measured as the shortest time interval at which both test stimuli evoked action potentials. The irresponsive period was measured as time interval between the two action potentials evoked.

In dystrophic muscle the absolute refractory period averaged 2.5 ± 0.1 milliseconds as compared with 3.6 ± 0.1 milliseconds for normal muscle. The irresponsive period was 3.5 ± 0.1 milliseconds for dystrophic muscle and 3.7 ± 0.1 milliseconds for normal muscle. The shorter absolute refractory period in dystrophic muscle is explained by a decrease in the intracellular potassium causing resulting increased excitability.

In peripheral nerve injuries the absolute refractory period was 50 per cent longer than in normal muscle. The irresponsive period was the same as the refractory period in both normal subjects and patients with peripheral nerve injury. The longer absolute refractory period in the patient with peripheral nerve injury is explained by the membrane changes that denervation brings about. These changes are reflected in a slower rate of repolarization and reduced conduction velocity.

In patients with anterior horn cell involvement the absolute refractory and irresponsive periods fall within the limits for normal muscle.

◇ **Problems of Anticoagulant Therapy in Cerebrovascular Disease. Sigmund N. Groach; L. J. Hurwitz; L. M. McDevitt, and Irving S. Wright. pp. 786-793.**

The problems and complications that arose in the course of anticoagulant therapy in patients with cerebrovascular thromboembolism were reviewed. The 108 patients were divided into two groups. In the first group the diagnosis of cerebral thrombosis was clear and the patients were randomly selected for anticoagulant therapy. In the second group the diagnosis of cerebral embolism was clear and the patients received anticoagulants on an obligatory basis.

A total of 22 patients (20 per cent) developed hemorrhagic complications. In two patients, these complications resulted in death. The incidence of complications in the embolism group was greater (26 per cent) than in those patients who had cerebrothrombosis (16 per cent).

The older the patient the greater was the incidence of hemorrhagic complications. Hemorrhagic complications usually appeared early in the course of treatment. Only five per cent of the patients treated for a period longer than 12 months developed a hemorrhagic complication.

Anticoagulant therapy, while feasible, involves definite risks and problems and great care and vigilance must be maintained when giving anticoagulants to patients with cerebrovascular disease.

Course and prognosis of acute cerebellar ataxia in children. *Weiss, Stuart, and Sidney Carter. p. 711.*

Incidence and type of pathologic alterations observed in muscle in a routine autopsy survey. *Pearson, Carl M. p. 757.*

The clinical syndrome of paroxysmal paralytic myoglobinuria. *Korein, J.; D. R. Coddon, and S. H. Mowrey, p. 767.*

ANNALS OF PHYSICAL MEDICINE. *Vol. 5, Aug. 1959.*

◇ **Rehabilitation of Fractures of the Shaft of the Tibia and Fibula. P. J. R. Nichols, and J. G. Parish. pp. 73-87.**

Over an 11 year period, 555 patients with fractures of the tibia and fibula were treated at two RAF rehabilitation centers. The main problems which were encountered in the rehabilitation of these patients were (1) the prevention of a faulty gait while the patient was in plaster, (2) the establishment of a limp-free gait after plaster was removed, (3) the development of calf muscle power and coordination, and (4) the prevention and treatment of post-plaster edema.

Patients transferred to the rehabilitation centers while still in plaster were taught correct ambulation, and after the plaster was removed, a limp-free gait was required to inhibit the formation of a poor habit pattern. The use of two canes or no cane at all was the rule in developing a limp-free gait. In patients where rehabilitation care did not begin until after the third post-plaster week, considerably longer periods of treatment were necessary to develop a limp-free gait. In this delayed group post-plaster edema had a greater incidence and took a longer time for resolution. The most effective method of preventing and treating post-plaster edema was the application of an elastic webbing bandage. Edema developed more frequently in those patients who had osteoporosis on radiographic examination at the time of removal of plaster.

Organized exercises in plaster did not result in a quicker return of ability, but the prevention and correction of a faulty gait in plaster resulted in more rapid normal walking when plaster was removed. The rate of recovery of ankle and foot mobility was of little value in estimating progress after immobilization. The development of gastrocnemius-soleus and quadriceps muscle power and coordinated movements, provided an accurate means of assessing the fitness of a patient.

◇ **Peritendinitis Calcarea Affecting the Hands. J. J. P. Lomas. pp. 94-95.**

A case report of a patient with peritendinitis calcarea at the head of the second metacarpal bone is presented. On clinical examination the patient had an acutely tender, warm, red swelling in the palm of the hand, resembling an acute cellulitis. A large amorphous mass of calcium was seen on x-ray. Immobilization was maintained for one week with relief of symptoms and disappearance of inflammation. Within three months the calcium deposit had disappeared.

Deposits of calcium around the tendons of the hand are uncommon and are probably due to local trauma resulting in a slight tear of a tendon or ligament. The deposits may be associated with an acute inflammatory reaction which must be distinguished from cellulitis, bursitis, arthritis, or gout. The diagnosis is established by radiographic examination. The condition is self-limiting, and treatment by immobilization, local hydrocortisone injections, and radiotherapy rapidly relieves symptoms and restores function.

Chloroquine in rheumatoid arthritis. *Buchan, J. F. p. 88.*

Current trends in the management of rheumatoid arthritis. *Ansell, Barbara. p. 97.*

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JOURNAL OF PHYSIOLOGY. *Vol. 48, Oct. 1959.*

◇ **The Effect of Mental Arithmetic on the Blood Flow Through Normal, Sympathectomized and Hyperhidrotic Hands. M. H. Allwood; H. Barcroft; J. P. L. A. Hayes, and E. A. Hirsjarvi. pp. 108-116.**

The effect of ten minutes of mental arithmetic on the blood flow in the hand was studied by venous occlusion water plethysmography in a room temperature of 21 - 23° C. In 26 tests on 16 normal subjects the average change in hand blood flow was +27 per cent for the whole ten minute period. In 19 tests on 11 patients who had cervical sympathectomies, the average change in hand blood flow was +5 per cent for the ten minute period. In five hyperhidrotic patients who exhibited visible sweating during the test, the average change in hand blood flow was +200 per cent. In six hyperhidrotic patients who did not show visible sweating during the test, the average hand blood flow change was less than +1 per cent. The increased flow in the normal subject probably reflects the associated slight elevation of blood pressure. The marked vasodilatation in the hyperhidrotic patients who sweat profusely was probably caused by bradykinin formed in the subcutaneous tissue during overactivity of the sweat glands.

◇ **Spatial Temperature Gradient and Thermoreceptor Stimulation. H. Hensel, and Ingrid Witt. pp. 180-187.**

Sensory fibers from cold thermoreceptors in the upper surface of the tongue of the cat were isolated from the lingual nerve and the action potential discharge frequency recorded. The upper surface of the tongue was kept at various constant temperatures while the lower surface was either cooled or warmed relative to the upper surface temperature. Cooling the upper surface directly or by conduction through cooling of the lower surface led to an acceleration of the discharge rate in the nerve fibers unrelated to the temperature gradients developed. It is concluded that the cold fibers are stimulated simply by cooling and not by the slope or direction of any intracutaneous spatial temperature gradient.

The effects of stimulation of the carotid body chemoreceptors on the pulmonary vascular bed in the dog: the "vasosensory controlled perfused living animal" preparation. *Daly, I. D., and M. D. Daly. p. 201.*

The effects of stimulation of the carotid sinus baroreceptors on the pulmonary vascular bed in the dog. *Daly, I. D., and M. D. Daly. p. 220.*

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JOURNAL OF NEUROPHYSIOLOGY. *Vol. 22, Nov. 1959.*

◇ **An Electrical Sign of Facilitation Accompanying Repetitive Presynaptic Activity. E. F. Vastola. pp. 624-632.**

This report is based on observations made in experiments on 45 cats with intracollicular transections which had been anesthetized with small amounts of intrapleural Surital. Conditioning orthodromic stimulation was delivered through the contralateral optic nerve by silver electrodes placed just behind the eye ball — one encircling and the other thrust into the center of the nerve. Antidromic stimuli were delivered by three silver wires insulated to their tips and placed in or just beneath the visual cortex at distances of one to two millimeters from each other. Recording was made from intact cerebral hemispheres except in seven experiments in which an attempt was made to isolate the lateral geniculate body from medial thalamic and preoptic structures by leukotomy in the parasagittal plane through the medial margin of the lateral geniculate body along its entire anteroposterior length. The lateral geniculate body was probed in a vertical direction through the cortex with a double barreled glass capillary electrode having an outside diameter at the end of about 75 to 150 microns.

Repetitive orthodromic stimulation of the lateral geniculate body at rates greater than 25 per second facilitated the antidromic propagation of an action potential into the cell bodies of the principal geniculate neurons. Facilitation was maintained at a constant level throughout the period of stimulation and continued into the post-tetanic period for as long as 500 milliseconds. Facilitation was accompanied by an electrical response (D.C. response) with a similar time course. Both facilitation and the D.C. response were changed in the same direction and by approximately similar amounts by changes in strength of frequency of the orthodromic stimulation. There was no D.C. response in the geniculate neurons or facilitation of the geniculate neurons by repetitive antidromic stimulation. The D.C. response appeared to be a logarithmic function of the frequency of orthodromic stimulation between 25 and 300 per second.

◇ **Effect of Cortical and Reticular Stimulation on Conditioned Reflex Activity. Emil Zuckermann. pp. 632-643.**

Investigations were made on 14 cats in which the blink reflex was studied as a natural conditioned reflex and on eight other cats in which the corneal conditioned reflex was studied as an elaborated one. A metronome set at 180 strokes per minute was used as the conditioned stimulus. The unconditioned stimulus was represented by an air stream projected on the cornea. In both groups eight cortical electrodes, each having a diameter of 100 microns, were implanted several days prior to the experiments on the unconditioned stimulus projection area (sensory motor area) and in the conditioned stimulus projection area (optic area in the first group, acoustic area in the second). Two pairs of electrodes were introduced in different zones of the reticular formation of the brain stem. All electrodes served to record both electric activity and stimulation. Electrodes were also implanted into the orbicular muscles of the eyelids in order to record the electromyogram.

Temporary connections for certain defense conditioned reflexes may be elaborated at a supramesencephalic level. This is suggested by the fact that they are inhibited after generalized seizures induced by cortical stimulation but not after brain stem seizures induced by reticular stimulation. The temporary connection probably occurs in cortical diencephalic structures which receive and analyze the conditioned stimulus. This might explain the fact that the focal convulsive discharges localized to the projection area of the unconditioned stimulus (sensory motor area) failed to interfere with conditioned reflexes, while similar focal seizures localized in the projection areas of the conditioned stimulus (optic or acoustic area) produce an important and prolonged inhibition of conditioned reflex. The mesencephalic reticular formation influences cortical and diencephalic neurons by augmenting in the same manner and proportionally both the excitatory process (elaboration of conditioned reflexes) and the process of active inhibition (differentiation). Furthermore, onset of supraliminar inhibition produced by reducing the interval to presentations of a conditioning stimulus, is much delayed after mesencephalic stimulation. There is no perfectly constant relationship between electrocorticographic signs of conditioning (occurrence of condition evoked potentials, desynchronization in the unconditioned stimulus projection area) and the conditioned behavior. These signs may remain dissociated throughout a series of stimulus associations. There is also no constant relationship between the

background cortical activity and the functional level of neural activity. The most significant modification of the electrocorticogram during higher nervous activity seems to be the appearance of slow, large waves (in these experiments modified by potentials evoked by rhythmic conditioned stimuli) during intense cortical activity connected to conditioned reflex elaboration and inhibition.

Reflex activity of the external anal sphincter of cat. *Bishop, Beverly. p. 679.*

Further observations on electrical activity of frog's spinal ganglion cells in sodium free solutions. *Koketsu, K.; J. A. Cerf, and S. Nishi. p. 693.*

JOURNAL OF CHRONIC DISEASES. *Vol. 10, Nov. 1959.*

◇ **Rheumatoid Arthritis: Historical Aspects. Charles L. Short. pp. 367-387.**

The author presents an excellent and concise review of the development of the concept of rheumatoid arthritis. Of particular importance is the concept of connective tissue disease which was introduced by Klinge about 30 years ago. Within the last 10 or 15 years the term collagen or connective tissue has come to be applied chiefly to periarteritis nodosa, systemic lupus erythematosus, dermatomyositis, and scleroderma in addition to rheumatic fever and rheumatoid arthritis. Not infrequently overlapping features or even typical pathologic features of two or more of these disorders are present in the same patients. Clinical manifestations of more than one may appear in the same patient either simultaneously or in sequence. For these reasons an etiologic relationship between these diseases has been postulated but remains unproved as yet.

The author points out that juvenile rheumatoid arthritis (Still's disease), Felty's syndrome, rheumatoid (ankylosing) spondylitis, psoriatic arthritis, arthritis of ulcerative colitis, intermittent hydrarthrosis, and palindromic rheumatism are a few syndromes regarded by some as varients of rheumatoid arthritis and by others as independent disease entities. Rheumatoid arthritis is described as a chronic inflammatory disease of unknown etiology and pathogenesis which is systemic in nature and characterized by the manner in which it involves joints. It is also considered to be a familial disease in that it occurs more frequently in the relatives of patients than of controls. Precipitating factors which have been implicated are strain, infection, exposure, operation and trauma. Fever and tachycardia are common findings and on the laboratory side, anemia is common, the mechanism of which is not fully understood. The immunologic characteristics of the disease are also discussed. The course of the disease is one of steady or intermittent progression although complete or nearly complete remissions may occur at first and certain patients recover without significant disability even after years of active disease. Etiologic concepts are discussed under the headings neurogenic, vascular, infectious, hypersensitivity, metabolic, endocrine and psychogenic. Of particular interest here is the possibility of vasomotor instability as a complicating factor. Treatment of the disease is divided into three aspects. The first is a basic regimen consisting of rest, a very adequate diet, the application of heat and exercises to preserve or improve joint or muscle function, prevention and correction of deformities by orthopedic measures, the relief of pain, and simple psychotherapeutic measures. The author points out that no control studies are as yet available to testify to the effectiveness of such a plan of management. The second aspect involves agents which suppress disease activity. Aspirin, phenylbutazone, and the corticosteroids all have anti-inflammatory effects. There is no reason to believe, however, that the disease course is altered by their use or that the fundamental pathologic process is completely arrested no matter how intensive or prolonged their use. The third aspect concerns the search for a truly curative agent.

Chloraquine phosphate and gold salts are believed by some to have a definitive temporary effect on the disease course. Again, carefully controlled studies have not yet been done to determine the true value of these forms of treatment. This is especially important in a disease which is subject to unpredictable spontaneous remissions and exacerbations.

It is obvious that the cure or prevention of this disease has not been achieved.

◇ **The Pathogenesis of Rheumatoid Arthritis. J. P. Kulka. pp. 388-402.**

This review is an effort to reconstruct the evolution of the anatomic features which characterize rheumatoid arthritis by comparative analysis of the classical lesions in various sites throughout the body, early or highly active joint lesions and rheumatoid nodules, and spontaneous and experimental lesions of known etiology which resemble those of rheumatoid arthritis. The lesions of rheumatoid arthritis are typically focal, localized to discrete regions and fall principally into three categories — inflammation of membranes which is predominately exudative or proliferative,

focal connective tissue degeneration and necrosis associated with nodule formation, and segmental vasculitis particularly involvement of venules and arterioles either within nodular or membranous sites of inflammation. The chief effects of the vasculitis are exudation and ischemia. The author stresses that evidence is growing that the vasculitis is a primary manifestation of rheumatoid arthritis as it is in the other so called connective tissue diseases.

Considering this variety of anatomic lesions, the question of a single pathogenetic mechanism adequate to account for all manifestations of the disease is raised. The author cites findings to suggest that the joint lesion of rheumatoid arthritis and rheumatoid nodules themselves result from a single pathogenic mechanism of which vasculitis is the cardinal manifestation.

Lesions such as produced by the Schwartzman phenomenon, those of local cold injury and those produced by various vasospastic agents such as pitressin and norepinephrine resemble the lesions of serum sickness and rheumatoid arthritis. It is interesting that vasospasm is frequently associated with these diseases. Indeed vasospastic disorders frequently precede the onset of rheumatoid arthritis. An additional factor not clearly understood is the possibility of local microcirculatory impairment, perhaps as a result of erythrocyte aggregation. The cardinal histologic feature to be stressed, however, is the segmental inflammation of venules and other small blood vessels associated with marked exudation.

The biochemistry of connective tissue. *Dorfman, Albert. p. 403.*

Immunologic aspects of rheumatoid arthritis. *Kunkel, Henry G. p. 418.*

Future lines of research on rheumatoid arthritis. *Thomas, Lewis. p. 428.*

CIRCULATION. *Vol. 20 (Part II), Oct. 1959.*

This entire issue is devoted to abstracts from the Thirty-second Annual Scientific Sessions of the American Heart Association held in Philadelphia on October 23, to October 25, 1959. A general list of topics discussed includes clinical cardiology, rheumatic fever and congenital heart disease, circulation, regulation of the cardiovascular system in health and disease, cardiovascular surgery, diagnostic technics, surgery in acquired valvular disease, congestive heart failure, basic science, concepts of atherogenesis, instrumental methods, cardiac resuscitation, arteriosclerosis, and mechanical methods of assistance to the failing circulation.

AMERICAN REGISTRY OF PHYSICAL THERAPISTS

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SUPPLEMENT II to *Directory* (14th edition)

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SUPPLEMENT II to *Directory* (14th edition)

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"Serenity emerges from four Faiths: Faith in Deity, Faith in Humanity, Faith in Life, and Faith in Self . . . the last of which is not the least."

◇ FROM THE ORACLES

etcetera . . . . . .

Principles and Practice of Geriatric Rehabilitation, a two-week course at Bird S. Coler Hospital is scheduled for April 25 — May 6, 1960, for registered nurses, occupational therapists, physical therapists and social workers.

The course is planned to provide intensified training in the rehabilitation care of the elderly chronically-ill patient and will offer a comprehensive and practical presentation of such care in hospital, home, old age home and nursing home. It will consist of lectures, seminars, clinical demonstrations and practice workshops. The teaching staff includes members of the faculty and professional staff of the Medical Center.

A tuition fee of $100 will be charged. A limited number of traineeships covering the tuition fee, travel and maintenance may be available through a grant from the U.S. Office of Vocational Rehabilitation. In addition, grants from the New York State Department of Health may be available for travel and maintenance to students who are residents of or who show evidence of intent to work in New York State.

For details, write Jerome S. Tobis, M.D., Chairman, Department of Physical Medicine and Rehabilitation, New York Medical College, 1 E. 105th St., New York 29, N.Y.

✶

Films, publications and exhibits on the vocational rehabilitation of handicapped homemakers may be had from the School of Home Economics, The University of Connecticut, Storrs, Conn.

✶

Spend Memorial Day Weekend in Chicago! The Midwestern Section of the American Congress of Physical Medicine and Rehabilitation will meet at the Rehabilitation Institute of Chicago on Friday, May 27, 1960. Program topics are prosthetics, orthotics and traumatic injuries of the spinal cord. Additional information may be had from Bernard J. Michela, M.D., Chairman, Rehabilitation Institute of Chicago, 401 E. Ohio St., Chicago 11 and/or Reuben R. Wasserman, M.D., Secretary, VA Research Hospital, 333 E. Huron St., Chicago 11, Ill.

✶

A new journal, WORLD NEUROLOGY, will be introduced in July, 1960. The journal will consist essentially of two parts: a scientific section and a section devoted to activities of neurologists and to neurological research throughout the world. Inquiries should be directed to WORLD NEUROLOGY, 84 S. 10th St., Minneapolis 3, Minn.

✶

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To stimulate interest in the field of physical medicine and rehabilitation, the American Congress of Physical Medicine and Rehabilitation will award annually, a prize for an essay on any subject relating to physical medicine and rehabilitation. The contest, while open to anyone, is primarily directed to interns, residents, graduate students in the pre-clinical sciences and graduate students in physical medicine and rehabilitation. The Awards and Prizes Committee suggests that members of the American Congress and American Academy of Physical Medicine and Rehabilitation bring this announcement to the attention of interested persons. The following rules and regulations apply to the contest:

1. Any subject of interest or pertaining to the field of physical medicine and rehabilitation may be submitted.

2. Manuscripts **must be** in the office of the American Congress of Physical Medicine and Rehabilitation, 30 N. Michigan Ave., Chicago 2, not later than March 1, 1960.

3. Contributions will be accepted from interns, residents, graduate students in the pre-clinical sciences, and graduate students in physical medicine and rehabilitation.

4. The essay must not have been published previously.

5. The American Congress of Physical Medicine and Rehabilitation shall have the exclusive right to publish the winning essay in its official journal, the ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION.

6. Manuscripts must not exceed 3000 words (exclusive of headings, references, legends for cuts, tables, etc.), and the number of words should be stated on the title page. An original and one carbon copy of the manuscript must be submitted.

7. The winner shall receive a cash award of $200.

8. The winner shall be determined by the Awards and Prizes Committee of the American Congress of Physical Medicine and Rehabilitation.

9. All manuscripts will be returned as soon as possible after the name of the winner is announced.

10. The American Congress of Physical Medicine and Rehabilitation reserves the right to make no award if, in the judgment of the Awards and Prizes Committee, no contribution is acceptable. Announcement of the winner will be made at the annual meeting.

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